DOCUMENT RESUME

ED 334 561 CS 010 653

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TITLE Teacher-Constructed Frames for Instruction with Content Area Text. Technical Report No. 537.
INSTITUTION Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Illinois Univ., Urbana. Center for the Study of Reading.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Aug 91
CONTRACT G0087-C1001-90
NOTE 73p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Charts; *Content Area Reading; Grade 4; Graphs; Inservice Teacher Education; Intermediate Grades; Learning Strategies; *Material Development; Reading Research; *Teacher Developed Materials; Teacher Effectiveness; Teaching Methods; Visual Learning
IDENTIFIERS *Graphic Organizers; *Organizational Frames

ABSTRACT

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ED334561

CENTER FOR THE STUDY OF READING

Technical Report No. 537

TEACHER-CONSTRUCTED FRAMES FOR INSTRUCTION WITH CONTENT AREA TEXT

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CS010653

The work upon which this publication was based was supported in part by the Office of Educational Research and Improvement under Cooperative Agreement No. G0087-C1001-90 with the Reading Research and Education Center. The publication does not necessarily reflect the views of the agency supporting the research.

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Abstract

An exploratory study developed ways to describe systematically a particular graphic organizer, the frame. For the study, 27 middle-grade teachers each constructed two frames on sections of fourth-grade science and social studies texts. Teachers also worked collaboratively in pairs and larger groups to produce frames. Collaborative sessions were audiotaped to record comments as teachers thought aloud during the framing process. Frame-based and text-based approaches were considered to analyze the teacher-constructed frames for variability and for content of important text ideas; a combination of these approaches emerged as optimal. The frame-based approach identified the types and organizational patterns of frames. An analytical unit, the Linked Concept Pair (LCP), was developed to describe the conceptual relationships in frames. The text-based approach used text idea units to analyze frames for content of important text information. These analyses showed that teachers' frames were considerably varied in structure and content; many frames were also found lacking in completeness, explicitness, and accuracy of information. In general, the frames produced by collaborative pairs seemed to be of a higher quality than those constructed by individuals or groups. Teacher talk revealed that the teachers' concerns for student understanding and teachers' level of prior framing experience affected every aspect of making a frame. Implications for future research and teacher inservice are discussed.

TEACHER-CONSTRUCTED FRAMES FOR INSTRUCTION WITH CONTENT AREA TEXT

One way that teachers can assist students with learning from expository text is by using graphic organizers. Graphic organizers represent important parts of the text through a distinctive spatial arrangement as well as through words. Graphic organizers include concept or semantic maps, structured overviews, and frames.

One indication of the widespread use of graphic organizers is their visibility in literature directed toward reading professionals. For example, the International Reading Association's (IRA) "bestselling" flip chart, *New Directions in Reading Instruction* (Monahan & Hinson, 1988), devotes 4 of its 27 pages to various forms of graphic organizers. Other recent IRA publications that devote chapters to graphic organizers are *Prereading Activities for Content Area Reading and Learning* (Moore, Readence, & Rickelman, 1989) and *Teaching Main Idea Comprehension* (Baumann, 1986). Similarly, a National Education Association (NEA) publication, *Teaching Thinking Skills: English/Language Arts* (Jones, Tinzmann, Friedman, & Walker, 1987), includes a major chapter section on graphic organizers.

Several theoretical perspectives provide insight into how graphic organizers can assist students in learning from text. According to Prawat (1989), organization and awareness are critical dimensions of a learner's acquisition and use of knowledge. Organization and awareness interact with the knowledge base, strategies, and personal disposition of the learner. Prawat emphasizes that "the key organizational factor is the elaborateness or richness of connections between units of knowledge" (p. 4). Because graphic organizers provide meaningful connections between main ideas of the text, they simulate cognitive representations of text information that interact with the knowledge base.

Schema theory provides another theoretical perspective that can be related to the use of graphic organizers in reading and learning from text. Schema theory is based upon a unit of mental structure called a schema, which is organized knowledge that has been stored in memory (Anderson & Pearson, 1984). Anderson and Pearson state that "A schema is an abstract knowledge structure . . . . A schema is structured in the sense that it represents the relationships among its component parts" (p. 259). When a schema gets activated, during reading for example, the abstract parts of the schema get "instantiated" with particular information about the text content topic.

Readers have schemata for content information as well as for expository text structure. Graphic organizers can combine the major elements of topic information with a representation of the overall rhetorical structure of the text. Schemata may function to "provide ideational scaffolding for assimilating text information" and may "facilitate editing and summarizing" (Anderson, 1985, pp. 376-377). With similar functions, graphic organizers may foster the construction of new reader schemata and may activate existing ones. In speaking of the top-level or macrostructure of text, Meyer (1984) states that "these organizational plans are patterns, frameworks, or ways of thinking about topic content and in the mind of the writer or reader can be viewed as a type of schema" (p. 5).

From another perspective of cognitive science, Mayer (1989) explains how a concept model, a verbal-spatial representation of a process, can aid the memory processes associated with information processing. As we read, we select and organize new information, building "internal connections" among the text ideas; we also integrate the new information with our previous information that is related to the current topic. Explicitly organized graphic organizers can aid the reader in selecting and organizing the information in the text. Mayer reviewed the results of 20 studies involving the use of explicitly sequenced concept models for use in science instruction with low-ability students. Students who used concept models along with the text outperformed the control group (who read only the text) on conceptual recall with a median difference of +57% (over 10 tests).

Researchers at the Center for the Study of Reading also have an ongoing interest in the use and effectiveness of graphic organizers. In particular, they are interested in the use of frames, which represent the main ideas of informational text and the relationships among them. An expression of this interest in frames is the Framing Project, a collaborative project between the Reading Center and a school district in a small city in Illinois. The Framing Project was started in the mid-1980s by Reading Center researchers and the school district reading coordinator, who shared the common goal of improving content area reading instruction (Armbruster, Anderson, & Meyer, in press).

The present study grew, in part, from concerns expressed by project teachers about the difficulty of constructing frames for instructional use. One purpose of this study was to identify some of the key aspects of the framing process.

Frames use verbal information within particular spatial designs in order to represent the main ideas of text and the relationships among them. Three basic types of frames are discussed by Armbruster (1985) and Ransom et al. (1989): the Description frame, Comparison/contrast frame, and the Explanation frame. Types of frames generally correspond to the overall rhetorical structures most commonly used in expository writing: simple listing, comparison/contrast, temporal sequence, cause/effect, and problem/solution (Armbruster, 1984; Meyer, 1984; Meyer, Brandt, & Bluth, 1980). These patterns, along with topic sentences and headings, create much of the overall structure or macrostructure of expository text. The last three text structures are typically represented with explanation frames. Although there are no rules for frame formats, the typical spatial formats associated with each text type are presented in Figure 1. Sample information has been written into the frame slots.

[Insert Figure 1 about here.]

By providing an explicit representation of the main text ideas and the structural relationships among them, frames can assist students in learning and summarizing the most important ideas from text. In a study by Armbruster, Anderson, and Ostertag (1987), fifth-grade students were asked to read three social studies passages with problem/solution structures. Then the students were given an essay test on one of the passages to assess their comprehension of top-level text structure. Students were also asked to summarize two other passages. The students who had received "structure training," which involved extensive use of instructional frames (constructed by one of the researchers), performed significantly better in recalling main passage ideas in their essays and their written summaries than did the group of students who had received traditional instruction that used written questions. In another study (Armbruster et al., in press) fourth- and fifth-grade students who had been instructed by teachers using frames did significantly better on matching and short-answer tests on social studies text chapters than did the students who had been instructed by teachers following the recommendations for instruction in the teacher's edition of the text.

This prior research and supporting cognitive theory provided the background for the present exploratory study of teacher-constructed frames. Whereas graphic organizers have been shown to be effective aids for student learning from text, we are unaware of any systematic way of describing frames for use in content area instruction. A major purpose of this study was to develop systematic ways to describe frames.

Additional impetus for the study comes from two other sources of concern. First, there is evidence that making a graphic organizer can be challenging. In his chapter on the spatial strategies in learning from text, Goetz (1984) states that the "development of a graphic representation can be difficult and time consuming" (p. 65). Research studies involving student construction and use of graphic organizers have taken periods ranging from six weeks (Berkowitz, 1986) to three months (Boothby & Alvermann, 1984). Finally, in the study by Armbruster et al. (in press), Framing Project teachers at each grade level (fourth and fifth) spent most of three full days of released time from teaching to prepare frames that represented three chapters of social studies textbooks.

Second, not all texts may be equally suitable for a spatial representation. Framing may not work equally well with all text passages or with all teachers. Berkowitz (1986) had independent raters (graduate students in reading education) judge three experimental passages for their suitability for idea mapping. A significant difference was

found favoring the suitability of one expository passage. On this passage, but not on the ones found less suitable for mapping, sixth-grade students who had been taught map construction significantly outperformed on recall tests of main ideas a comparable group of students who had been taught by a question-answering method. Framing Project teachers (Armbruster et al., in press) also expressed the opinion that the fourth-grade text (a mixture of geography and history) was much harder to frame than the fifth-grade text (history focus only). An additional finding from this study was that there was a significant interaction between the teacher and treatment conditions. Some teachers taught more effectively by using the question-answer method from the teachers' edition than by using frames.

These factors of task difficulty and text suitability complicate the production and study of frames. However, if a system for describing frames can be developed, then criteria for completeness, explicitness, and accuracy of information as well as for clarity of the representation of text might be objectified. Once these criteria have been established, then perhaps frames can be evaluated by standards of quality. More importantly, the criteria for judging frames can become a foundation for preparing teachers to construct frames that will effectively aid students in learning from text. To develop a knowledge base about teacher-constructed frames, this study addresses the following four questions:

1. How can instructional frames be described in a systematic way?

2. To what extent do individually constructed frames (based on the same section of text) have similar structure and content?

3. To what extent are the important concepts of text represented in frames?

4. What are some of the teacher concerns, decisions, and difficulties related to framing processes?

An additional strand of the research that ran through all four questions involved collaborative work. Teachers constructed frames individually and in collaborative work units. Part of the study examined the influences of collaborative work on the frames and on the framing process.

Method

Subjects

The subjects were 27 third-, fourth-, fifth-, and sixth-grade teachers from 18 schools within a single school district in a small city in Illinois. These teachers were participants in the ongoing Framing Project. Of the participants, 6 were former project participants and 21 were new to the Framing Project.

Materials

Instructional. The research team used two demonstration texts, one in science and one in social studies, published by different commercial textbook companies. Both texts were designed for use at the fourth-grade level. Additional materials included several demonstration frames that the first author had prepared. The booklet *Framing Information* (Ransom et al., 1989) was the basis for more general background information provided to teachers. Teachers were given an overview of the types of frames (Description, Comparison/contrast, and Explanation) that correspond to the macrostructure of expository texts. They were shown some typical graphic formats (branching tree, chart or table, and chain) for framing expository texts.

Experimental. The experimental materials consisted of two text lessons, one in science and one in social studies, from commercially published fourth-grade textbooks. This grade level was chosen because about three fourths of the teachers were currently teaching fourth-grade classes. Each lesson was about 500 words long.

The science lesson "Cone-Bearing Plants" (Barman et al., 1989) describes conifers in the second of three lessons in the chapter "Kinds of Plants." The lesson begins with the definition and distinguishing characteristics of cone-bearing plants, goes on to discuss conifers in two sections with the headings "Life Cycle of a Conifer" and "Kinds of Conifers," and ends by directing students to examine pictures of conifers in the text. A copy of this textbook passage appears in Appendix A.

The social studies lesson "England and Wales in 1976" (Parramore & D'Amelio, 1979) was the first of three lessons on water from a chapter titled "A Limited Resource." Unlike the lesson on conifers, this lesson was not divided into sections with headings. This lesson begins with a description of how drought conditions in England and Wales in 1976 affected people and animals, continues with an explanation of how people saved water, and closes with the end of the water crisis and with some reflective comments on the choices that people had made about how to use water. A copy of this passage appears in Appendix B.

To compose their frames based on these texts, teachers were provided with blank, unlined paper. Materials for collaborative work included photocopies of teachers' individually constructed frames on the two experimental lessons, blank paper for collaborative framing, and audio-cassette recorders with tape for recording teacher talk. We also developed some guidelines to assist teachers as they worked in pairs and larger groups. These guidelines contained several goal statements, suggestions for getting started, and procedures for dividing the framing work responsibilities. In general, we developed goals and procedures with this process in mind: Teachers would collaborate to make a frame on the same text that they had previously framed alone. We also told the teachers that we expected their collaborative frames to be different in some way (however slight) or ways from their previous frames. Thus, we expected that collaborative frames would truly reflect the work of each member of the pair or group.

Measures

Frames. The teacher-constructed frames were viewed as representations of each text's main ideas and their linking relationships. Frames were analyzed in terms of (a) the degree of similarity of their structure and content, and (b) the occurrence in them of important text idea units. In both these processes, the frames produced individually were compared to those produced collaboratively over the same section of text.

Individual framing questionnaires. A questionnaire was administered to each teacher after she or he completed the first frame on either the science or social studies text. A copy of this questionnaire appears as Appendix C. An identical questionnaire was administered after completion of the second frame in the other content area. These items asked teachers to rate their reactions to several aspects of the framing task that they had just completed. Teachers were also asked to rank order their estimate of the relative influence on their framing work of the following sources: the teacher's prior knowledge of the subject matter topic, the teacher's prior experience with framing, and the text that the teacher framed. Lastly, in open-ended questions, teachers were given an opportunity to comment on the hardest and easiest things about making the frame.

Design

In this study there were two treatment conditions, each at two levels: *order* of framing task (science text first or social studies text first) and *content area* (science text or social studies text). Each teacher worked individually in making two frames, one based on a science lesson and one based on a social studies lesson. Thus, each teacher served as her or his own control on the content area condition.

Furthermore, teachers used one of their own individual frames as the basis of new frames to be produced collaboratively (on the same sections of texts represented by the original, individual frames). There were two collaborative work units, pairs and groups. Teachers used one of their own individual frames in work with another teacher (a pair unit) and their other individual frame in work with five to seven other teachers (a group unit).

For these experimental tasks, teachers were randomly assigned to four groups (A-D) within the following constraints: Teachers from the same schools were assigned to different groups; the six returning project members were balanced to the extent possible among four groups (Groups C and D each contained two former project participants). These constraints were used in order to balance the groups for prior professional relationships and framing experience among teachers. We hoped to minimize these influences in the teachers' collaborative work in pairs and groups. Ideally, the experiment called for four balanced groups of six participants each, but we had to accommodate all 27 teachers. Thus, Groups B and D each had seven members, Group C had eight members, and Group D had six members. The experiment also called for pair assignments. Within each group, teachers were randomly assigned to pairs, with the same constraints applying to pair assignment as to group assignment. To accommodate the odd-numbered total of 27 teachers, we assigned one teacher to two groups, so she did not work in a collaborative pair unit.

Procedure

The demonstration texts and the booklet *Framing Information* (Ransom et al., 1989) were distributed. Then two members of the research team presented teachers with oral and written information about framing. Two points were emphasized during the presentation: (a) that frames represented central text ideas and only the most significant details, and (b) that although there is no single "best" frame to represent a given section of text, there are standards, such as faithfulness to text and clarity of representation, that distinguish frames of high quality from those of low quality. The first author discussed the two demonstration frames, commenting on both the content of the frames and the process used in constructing them.

A packet of experimental materials was given to each teacher. Included in the packet were the experimental texts, individual framing questionnaires, and individual and specific assignments to collaborative pairs and groups. The teachers were instructed to complete the framing tasks and questionnaires in the prescribed order. All teachers were observed to follow these directions. In response to a teacher question, an announcement was made prior to the individual framing. Teachers could use their own discretion concerning whether to use more than one frame to represent each content area lesson.

Following the demonstration, the teachers read their first lesson, framed it, completed the questionnaire on frame No. 1, and then turned in all of these materials. To balance order of text, 14 teachers framed the science lesson first, and 13 teachers framed the social studies lesson first. For the second framing task, the same general procedures were followed. Both framing tasks and questionnaires were completed in about 1½ hours.

After a short break, teachers began their collaborative work using photocopies of their individual frames. In this first period of collaborative work, roughly half the teachers who had framed a given text first worked in pairs while the other half worked in groups. Each of the larger groups used adjunct rooms. The seven pairs spread out in one large room. One member of the research team acted as a facilitator in each room. Teacher talk was audiotaped during this period. Collaborative framing work was completed in about 45 minutes.

After a break for lunch, the teachers completed their second collaborative task, which was in a different work configuration (pair or group) and in the different content area from the earlier collaborative work. The same procedures were followed as in the first collaborative period. This period concluded the experimental procedures, but the workshop continued with a focus on using frames as prompts for student writing.

Data Analysis: Experimental Texts

To determine the structural importance of idea units within the lesson, the lessons were first parsed into idea units. The main clause was the basic unit; however, several instances of individual words or subordinate clauses were included as discrete idea units, such as the lesson and section headings, picture captions, and, in the science text, a graphic inset entitled "How Conifer Seeds Develop." These features were included because they are intrinsic parts of the text. On the other hand, adjunct questions, a map of England and Wales, and definitions

of special terms that appeared in the text margins or at the end of the lessons were not included in determining idea units. The science lesson on conifers was thus parsed into 68 idea units, and the social studies lesson on the drought was parsed into 59 idea units. Next, a rating form was developed for each text lesson, with each of the idea units as an item. A number scale from 1 to 4 appeared alongside each item, with

1 = not important

2 = somewhat important

3 = fairly important

4 = very important.

Then, copies of these rating forms, along with a reference photocopy of each experimental text (as it appears in the textbook), were given to 14 independent raters (graduate students in education). Raters were instructed to rate each idea unit based upon its importance to the overall structure and thesis of the lesson. Eight of the completed rating forms were used in the analysis of idea units of each text. Twelve completed forms had to be discarded because not all of the items were rated or the full scale was not used. Means and standard deviations were computed for each rated item.

Next, the text idea units for each content area text were divided into two roughly equal groups: "relatively unstable" and "relatively stable" idea unit ratings. This grouping was accomplished by rank ordering the text idea units by the *standard deviations of their mean idea unit ratings*. Half of the rated idea units with the highest standard deviations were judged to be relatively unstable text idea unit ratings and were discarded. The half of the rated idea units with the lowest standard deviations were retained for each text. With respect to the 4-point importance-rating scale, the "relatively stable" ratings of science text idea units had standard deviations that ranged from 0.0 to .60; for social studies text idea units, the corresponding range of standard deviations was from .43 to .71.

These "relatively stable" text idea unit ratings for each text were then rank ordered according to the *means of the idea unit ratings*. From this group of relatively stable text idea units from each text, 15% of the highest rated and 15% of the lowest rated text idea units were selected to use in analyzing the presence in the frames of the important text ideas.

Data Analysis: Experimental Frames

1. How Can the Frames Be Described?

To study instructional frames as representations of text, we considered two approaches, one starting with the frames and the other starting with the expository text.

In using a frame-based approach, one starts with the frames and systematically identifies and codes the concepts and the rhetorical links between them. Each pair of concepts and the relationship connecting them forms a Linked Concept Pair (LCP). An analysis of LCP units reveals the content and relationships used in the frame. For this analysis, we used the term *concept* in a technical sense that may not correspond precisely to the way *concept* is used by others. In our usage, a concept may be a single word, phrase, or clause.

The 11 rhetorical links captured in LCP units are named, defined, and exemplified in sentences in Table 1. For convenient reference, each of the link labels has been numbered. Most of the examples are presented as simple sentences, such as in the illustration of Example (3): "A bristlecone pine is a conifer." In this case, the LCP consists of a modified word (*bristlecone pine*), a word (*conifer*), and their relationship. Occasionally, a complex sentence is used to present an example, such as in the illustration of Effect (5): "Because crops were lost, the

price of vegetables rose." In this case, the LCP consists of two clauses and their relationship. Sometimes a concept pair could be linked by more than one rhetorical relationship. Consider the statement "A pine is a conifer." Here, pine could be seen as an Example (3) of a conifer or as a Type (4) of conifer. To identify and code this statement appropriately, one would be guided by the context of the frame and of the expository passage. Either or both rhetorical relationships might be appropriate. Since most of the LCPs are based upon independent clauses and their modifiers, there is at least a general correspondence between these LCP units and the text idea units. A closer comparison of the LCP and idea units is developed later in this report.

[Insert Table 1 about here.]

In using a text-based approach to frame analysis, on the other hand, one starts with the list of text idea units, such as those that were prepared for the rating of text idea units on the conifer and drought lessons. Then one systematically analyzes the frames, noting each instance when the information in the frame matched that in an idea unit.

We used both approaches to analyze the science and social studies frames. By the toss of a coin, the first author used the frame-based approach first with the conifer frames and used the text-based approach first with the social studies frames. As indicated in the analysis of data for Research Question 2 (on the similarity of frames), the frame-based approach was used on all of the frames, first in science and then in social studies. As indicated in the analysis of data for Research Question 3 (on the representation in frames of important text idea units), the text-based approach was used *in full* only with the social studies frames. That is, all of the social studies frames were systematically analyzed with respect to all of the text idea units. (This procedure was not carried out with the science frames because of significant limitations that arose in the coding of the social studies frames; these difficulties are fully discussed as part of Research Question 3.) A *partial analysis*, however, was carried out with the science frames. Using a text-based approach, all of the science frames (as well as the social studies frames) were systematically analyzed for their representation of the highest rated and lowest rated text idea units.

2. How Similar Were the Frames?

2A. Types and basic organization. Frames were coded according to type, described earlier as Description, Comparison/contrast, or Explanation. (This procedure is an application of the frame-based approach to analysis.) Based upon the concept of "stacked knowledge maps" ("k-maps") described by Rewey, Dansereau, Skaggs, Dees, and Pitre (1990), a further classification was carried out. In the present study, the notion of stacked k-maps was modified to describe frames that were embedded within the overarching, primary frame. In working on the science text, in particular, some teachers made two primary maps, one map for kinds of conifers and the other for life cycle of conifers. Other teachers chose to make the representation of life cycle a part of a larger frame and thus embedded the life cycle frame within the hierarchy of the primary frame (as in Figure 2). Frames thus embedded were classified as secondary frames. Frames were coded by their apparent organization as a primary or secondary frame.

2B. Structure and content: The Linked Concept Pair (LCP). In another application of the frame-based approach to analyzing frames, each frame was coded according to the concepts and the relationships that connected them, with each LCP unit consisting of two concepts and one link connecting them. The concepts were the information from the text lesson that was represented in the frame. The rhetorical links were introduced earlier and discussed in connection with Table 1. These are similar in function to some of the logical and temporal relationships in the microstructure of expository text as described by Herman, Anderson, Pearson, and Nagy (1987). These relationships also can operate in topic sentences and lesson titles, and are thus applicable to the macrostructure of text as well. Sometimes these relationships were "signaled" (Meyer, et al., 1980) with words like *but*, *another*, *different*, or *begins*. These signals contribute to the "local coherence" (Armbruster, 1984) of the text, but the readers (teachers and researchers) must infer many of the logical relationships between ideas that are developed in the lessons, represented in frames, and coded as LCP units.

The system used by Anderson and Huang (1989) for coding concept maps was modified and extended for coding LCP units. Figure 2 illustrates this coding system with a science-text frame composed by one of the teachers during the study. Part A shows the frame, which has one primary description frame and has embedded within it one secondary explanation frame under the category label *Life Cycle*. Part B shows the coding of the frame in Part A.

[Insert Figure 2 about here.]

In the left-hand side of Part A, there is a descending hierarchical relationship from *Cone-Bearing Plants* to *Kinds of Conifers* to *height* to *tall* or *shrub*. Note that these relationships are represented in Part B as a connected series of LCPs. (The link code *0* usually signifies a frame's topmost category labels and is discussed later in detail.) Below the title LCP, *Kinds of Conifers*, is one aspect of *Cone-Bearing Plants*; *size* (height) is one aspect of *Kinds of Conifers*; and *tall/large* and *short/low/shrub* are the two types of *size*. Thus, *tall* and *shrub* are directly related through the hierarchy to *Cone-Bearing Plants*. This coding hierarchy parallels a pattern in text itself, which Meyer (1984) calls a "*hierarchy* of content."

Similar reasoning applies to the sequential relationships of the life cycle of conifers, which is also represented in both parts of Figure 2. Each LCP unit was assumed to be part of the superordinate category *Life Cycle* as well as to be a phase in the sequence from the production of pollen to the growth of a new tree. The coding of "male" and "female" as types of cones (right-hand columns of Figure 2, Part B) may be puzzling at first. In the frame (Figure 2, Part A), the male and female cones are represented only as information in phase 1 and phase 3 of the life cycle; they are not represented as types in the hierarchical way that *tall* and *shrub* were shown as types of *size*. Here the analysis was guided by the text as well as the frame. In the discussion of the life cycle, the text states that conifers have two kinds of cones, male and female. Further on in the text, the male and female cones are mentioned according to the roles that they play in the life cycle. In the frame, the information that identifies two types of cones is embedded within the other information in phases 1 and 3 of the life cycle. Because a frame is a condensation of text as well as a representation of text, it was decided that this frame included both sorts of information on cones, their genders and their roles. Thus, even though this analysis was frame-based, the text was an essential resource in the coding process.

Part B of Figure 2 also shows the menu of *Link* choices for LCP units. The *0* link was used mainly to indicate a frame's topmost category labels. Although the *0* link described some of the text macrostructure, the LCP coding system was not very sensitive to the differences between text macrostructure and microstructure. The *0* link was also used to indicate other superordinate category labels, such as *size* or *shape*, which do not define a characteristic particular to conifers. The discussion of size and shape appear as significant details in the lesson text, rather than as topic sentences. Needles, on the other hand, are introduced in a topic sentence. The first LCP coding for needles has *needles* linked by a *2* (not *0*) to *Kinds of Conifers* because needles are a distinctive characteristic of conifers.

The frame-based LCP approach was also used to code the frames of the social studies text. Some of the teachers used as a model one of the frames presented in the *Framing Information* booklet (Ransom et al., 1989). This model is presented in Figure 3.

[Insert Figure 3 about here.]

The Problem/Solution frame has two major divisions--the Problem half and Solution half--with each division having two parts. Each part is causally related to the other; for example, in the Problem half, the situation produces an effect. Note that the numbered concepts under *Situation* correspond to the numbered concepts under *Effect on People*. For example, the lack of food caused starvation and death among the Bushmen.

Many teachers used this model in constructing their frames on the drought in England and Wales in 1976. An example of a teacher-constructed frame is presented in Figure 4, Part A. Part B shows the LCP Coding of this frame.

[Insert Figure 4 about here.]

The Problem half of this frame on the drought in England and Wales is divided into two parts, *Situation* and *Effect on People*. In addition, the arrow between the boxes indicates a causal relationship between the *Situation* and the *Effect on People*. The six numbered effects listed in the right-hand box are the results of the corresponding situations listed on the left. For example, because crops were lost, the price of vegetables rose. In Situation 3, two causes are listed, "trees began to die" and "forest fires." The corresponding effect is stated as "fewer trees to enjoy." These relationships represent the teacher-framer's confusion of two text concepts. Early in the text lesson, the reader is informed that "trees began to die" and "forest fires became a great danger" (Parramore & D'Amelio, 1979, p. 124). This causal relationship was not inferred by the teacher-framer. Instead, she combined this concept with one occurring later in the lesson after several intervening topics are discussed. Then the text reports that, as the drought lengthened throughout a hot, dry summer, "Many forest fires caught fire" (Parramore & D'Amelio, 1979, p. 125). Whereas this framer made an inference based on her prior knowledge that there were now "fewer trees to enjoy," most of the other teachers made a text-based inference connecting the second text statement on forest fires to text statements about the fire fighters working day and night to prevent the fires from spreading. Although these LCPs on the forest fires are accurately stated, the relationships are not quite faithful to the text.

Part B of the figure shows how all of these relationships were coded as LCP units. Nearly a third (9 of 28) of the LCP units illustrated here would also be appropriate codings for any other frame that used the ready-made format for a Problem/Solution frame. Note that *Situation* and *Effect* are "parts" (11) of the *Problem* and that *effect* is the "effect" (5) of the *Situation*. The specific relationships between text concepts on the drought situation and effects are coded with a *5* to show cause and effect. The *2-5* coding indicates an incomplete relationship between "trees die" and "danger of forest fires." All of the other causal relationships in the frame were faithful to the text or to reasonable inferences based upon the reader's prior knowledge.

Complex rhetorical links also exist for the Solution half of the frame, which is also divided into two causally connected parts, *Actions* and *Results*. There is an additional coding feature represented here that did not occur in the Problem half of this frame nor in the coding of the conifer frame presented in Figure 2. An examination of the Solution half of the drought frame shows that five actions led to several (unnumbered) results. No one of these actions directly led to one of the results; instead, the *combination* of these actions and others led to the results described in the right-hand box. Because there was no one-to-one correspondence between actions and results, the results were not numbered. The LCP codings reflect this causal relationship in a "split-halves" entry. The actions coded on the left are connected causally to those on the right, but there is not a one-to-one relationship represented here as there was in the Problem half of the frame and its coding.

Thus, the LCP coding of this frame has two features not found in the coding of the science frames on conifers, the standard elements of the ready-made format for the Problem/Solution frame and the "split-halves" coding. The latter was used for concepts that have a causal relationship but for which there is not a one-to-one correspondence between each cause and an effect; that is, a group of actions produced a group of results.

To code the frames in science, the first author began by constructing a "master frame," based upon his own reading of the text lesson. This "master frame" descended to low levels of topic detail and consisted of 50 LCP units. These units were entered as a coding template using the Lotus 1-2-3 computer software (*Lotus 1-2-3 Release 2.2*, 1989). A total of 27 individual frames, 7 pair frames, and 2 group frames were independently coded for the lesson on cone-bearing plants.

All of the information on the science frames was translated into LCP units, which were tallied with respect to the coding template. Early in the process, it became obvious that the frames represented in various ways the same text concepts. In many instances, the variation could be accommodated by the original LCP unit. For example, *short*, *low*, and *shrub* appeared in separate frames to represent same concept, so they were combined in one LCP unit as were *size* and *height*: *short/low/shrub 4 size (height)*. In other instances, new LCP units were created to account for the relationships that were not encountered in previous frames; thus the template was expanded. Many of the additional LCP units involved incomplete or inaccurate versions of the LCP units already in use. (These variant versions are discussed in detail later in this report.)

The process of coding 36 frames yielded 167 LCP units. Then the content of every information slot of all 36 frames was checked to be sure that they were properly coded. The total was 1,185 occurrences of LCP units in the 36 frames (881 from individual frames, 227 from pair frames, and 77 from group frames). With respect to LCP units, each data item from all 36 frames was coded according to the category of its origin in an individual, pair, or group frame. Thus, the frequency and proportion of all LCP unit occurrences in individual, pair, and group frames were calculated.

To code the social studies frames, the same procedure was followed (except for the source of LCP units) to make a coding template on the Lotus 1-2-3 worksheet. In this case, the first author started with three of the teachers' frames, the one that was presented in Figure 4 and two others, one a Description frame and the other a Problem/Solution frame with many statements that appeared to have been copied directly from the text. These three frames provided a good foundation of 80 LCP units. As with the conifer frames, new concept relationships were encountered during the coding of the 35 drought frames, resulting in an expanded template of 156 LCP units. There were 853 occurrences of LCP units (650 in 27 Individual frames, 157 in 6 Pair frames, and 46 in 2 Group frames).

2C. Detailed LCP analysis: Selected concepts. As mentioned earlier, some LCP units were created as variations of existing LCP units to account for incomplete or inaccurate representations of text. In still other cases, variant category labels were used in frames and thus were coded. For example, the science text used the heading "Kinds of Conifers." Some frames used this heading explicitly as a category label, but, in referring to the same text details, other frames had an implicit version of the heading as a category label: *Characteristics of Conifers*.

Some of these variations were analyzed systematically if they met the following criteria: The variations could be distinguished precisely; they involved linked concepts that were important to the text macrostructure or appeared widely in teacher frames. Then the variant representations were further analyzed for structural differences, completeness of information, and accuracy. Frequency distributions were calculated for the LCP codings of variant representations of the same text concepts. Figure 5 illustrates variant frame parts with corresponding LCP codings for the ways that subordinate details of conifer size, shape, and characteristics are grouped and hierarchically connected in each partial frame.

[Insert Figure 5 about here.]

In Quadrant A of Figure 5, the EXPLICIT representation is identical with that presented in Figure 2. In this partial frame, *tall* and *short* are grouped in a category explicitly labeled *size*; the same organizational pattern is used for the information about conifer *shape*. The IMPLICIT representation (Quadrant B), like the *explicit* one, has precisely grouped information; however, the *implicit* category does *not* give each subordinate group an explicit label. That is, *tall or short* is directly connected to *Kinds of Conifers*. The LCP codings reflect the differences between the explicit and implicit frame representations. In the explicit coding, *tall* and *short* are Parts (4) of *size*; in the implicit coding, *tall* and *short* are Parts (4), or divisions, of *Kinds of Conifers*. To code the GENERAL representations (Quadrant C), a *2-* prefix was used in combination with the usual LCP link. This coding means that the relationship was not as precise as the information in the text. In the example, *tall* is no more related to *short* than *short* is to *oldest plants*, and so on for the other divisions of *Kinds of Conifers*. Thus, this partial frame represents an incomplete grouping of related information, and a general listing of the concepts is

presented. For the INACCURATE (or misleading) representations shown in Quadrant D, a *3-* prefix was used in combination with the usual links. In the example, the usual categories of *size* and *shape* are confused.

Using the criteria for selecting concepts that was described above for conifer frames and text, we chose for detailed analysis some concepts that appeared in many social studies frames. These concepts were typically presented in the Problem half of the standard format, as in the sample teacher frame presented in Figure 4. Figure 6 shows a variant partial frame with many similar concepts. Like the frame in Figure 4, the teacher-constructed frame in Figure 6 presented text information in the standard Problem/Solution format. The LCP units for the standard frame format are the same as those in Figure 4, but there the similarity ends between the two frames. In contrast to Figure 4, Figure 6 does not specify the Problem at the superordinate level. Instead, that information appears under *Situation*. Although the information listed under *Effect on People* did result from the drought, the listing by itself does not indicate any of the precise causal relationships that link some of the statements. For example, there is no apparent connection in the frame between Item 1 and Item 3, but one can logically infer from the text that the loss of crops caused the rise in vegetable prices. Even within Item 4, there is no causal connection made between the rats and the spoiling of water; the semicolon does not by itself express a causal relationship! These variant representations of causal relationships were examined for completeness and accuracy in a detailed analysis of eight LCPs in social studies.

[Insert Figure 6 about here.]

2D. Detailed analysis: Standard Problem/Solution frame format. Because many of the frames in social studies followed the standard Problem/Solution format, one way to determine the similarities among the teachers' frames was to examine them for the features that appeared in the model presented as Figure 3. Some of the project teachers used an alternate standard format for the Problem/Solution frame. This had been presented to them in other workshop sessions of the Framing Project. This format simplifies the Problem part of the frame, combining *Situation* and *Effect on People* into one information slot. The superordinate *Problem* slot has been retained. The Solution part of the frame still uses *Action* and *Results* as slots, but the label *Solution* is not included. These formats were considered equally valid models for the teacher-constructed frames. With respect to the structure of the standard formats, the teacher-constructed frames were analyzed for completeness, explicitness, and accuracy.

[Insert Figure 7 about here.]

COMPLETENESS was defined as having five (four, in the case of the alternate format) categories of information in an explanation frame: In the standard format of the Problem/Solution frame these category labels are *Problem*, *Situation*, *Solution*, *Action*, *Results*. (In Figure 3, *Solution* is a label, which was necessary for completeness, but is not a slot for information.) The partial frame in Figure 6 had five categories and, in terms of the format, was complete even though the Problem slot was labeled but not filled. EXPLICITNESS meant that all of the category labels, numbers, and arrows were included in their appropriate places *as they were presented in either Figure 3 or Figure 7*. For example, a frame that did not have all of the arrows indicating causation was not considered to be explicit. A frame that substituted the label *Changes Made* for *Action* was also not considered to be an explicit version of the standard format. ACCURACY meant that all of the relationships indicated by arrows and numbers between and within frame slots were valid, that is, logical with respect to reasonable text-based inferences. Thus, the partial frame in Figure 6 was inaccurate; causes and immediate effects were confused in the frame and were presented just as Effects of a long-term cause, the drought.

The social studies frames were systematically analyzed for completeness, explicitness, and accuracy with respect to their use of a standard Problem/Solution format. The data were recorded on a Lotus 1-2-3 worksheet. As a point of reference, the teacher-constructed frame in Figure 4 was judged to be complete, explicit, and accurate. It should be noted that the standards for completeness, explicitness, and accuracy were defined differently in this analysis from the way they were defined and used in the LCP analysis of selected concepts. In the LCP analysis,

the relationships between linked pairs of concepts were considered with respect to their immediate context within the frame. In the analysis of the use of standard formats, however, the relationships between major sections of the frame were considered.

2E. Collaborative work. The effects of collaborative work were determined in several ways. All of them involved comparing the results of the numerical analyses of individual frames with the results for pair and group frames. The frequency totals of the various units of analysis such as LCP units were first calculated as proportions to make possible meaningful quantitative comparisons. This procedure was carried out with respect to the basic type and organization of frames (2A). Did one type of frame dominate the individual work and another type dominate the collaborative work? For another analysis of collaborative work, the LCP data on the structure and content of frames (2B) were examined in two ways. First, the "new LCPs" were tallied and identified. New LCPs were units that occurred in pair and group frames but had not occurred in the frames of the individual members of the collaborative unit. Second, a tally was made of the LCPs that did not occur in collaborative frames but occurred in all of frames of the individual members of the collaborative work unit. These two procedures would give some indication of the collaborative work as a process of revising the frames that had been produced alone. For the detailed analysis of selected LCPs (2C), the data were examined for the relative proportions of explicitness, completeness, or accuracy in individual and collaborative frames. Did the collaborative process eliminate a portion of the faulty relationships present in the individual frames? Finally, with respect to the social studies frames, the effects of collaborative work were considered by examining the data on the use of the standard format of the Problem/Solution frame (2D). With respect to the criteria of completeness, explicitness, and accuracy, the proportional occurrence of these qualities in individual frames was compared to their proportional occurrences in the pair group frames.

3. To What Extent Were Important Text Idea Units Represented in Teacher-Constructed Frames?

3A. Text-based frame analysis: Social studies. The social studies frames were analyzed first with respect to their content of text idea units. (Later the frames were analyzed for their content of LCP units.) To code the frames, a Lotus 1-2-3 worksheet was used as a coding and tally sheet. The 59 numbered text idea units from the importance rating form were the rows of the worksheet; teacher frames were represented in the columns by individual, pair, and group number designations. Then the contents of each frame were examined, and each slot was compared to the list of text idea units. A copy of the original social studies lesson was consulted from time to time to check for context.

A tally mark was entered into the data worksheet for each occurrence in a frame of a text idea unit. For example, consider this information from the teacher frame presented in Figure 4: "Problem--Lack of water (drought) in England/Wales 1974 - Sept. 1976." For this information, tallies were made for six idea units, each of which contributed some key information to the superordinate statement in the teacher's frame. Consider comparable information from another teacher's frame: "Problem--Drought in England and Wales . . . 1. Very little rain and snow in 74 and 75. 2. Less rain in Jan, Feb, and March of 76. 3. Still less rain in April. 4. Continued lack of rain until August . . . ." Although both frames contain information that came from the same source idea units, the first teacher made a gist statement, and the second one virtually copied phrases from the text into the frame slots.

Thus, this system of coding was not precise enough to make distinctions between these two ways of representing text idea units. This condition was seen as a drawback of a text-based approach to a full-frame analysis. Another limitation to the text-based approach is that there are no text idea units to use for the non-text information that appears in frames, such as some information slots, some category labels, and some information which has a source in the framer's prior background knowledge. Thus, we decided not to do a full analysis of the conifer frames with the text-based approach.

3B. Analysis of highest rated and lowest rated text idea units. Although an analysis of all the text idea units that appeared in frames was not carried out, all of the frames were analyzed for their content of the text idea units that were judged by the independent raters to have the highest and lowest importance in the development

of the thesis of each text lesson. Only those idea units with relatively stable mean importance ratings were considered. The highest 15% and lowest 15% of these text idea units were selected for analysis of frequency of occurrence in frames. In the case of ties (in mean importance ratings and their standard deviations) at the cut-off points, the amount closest to 15% of the idea units was chosen.

The 15% figure was chosen because there was likely to be a relatively large difference in mean importance ratings between the groups of highest and lowest rated idea units for each text. For the science text, the grand mean of the mean importance ratings of the highest rated 15% of text idea units was 3.75 (*sd* = .20); for the lowest rated 13% of text idea units the grand mean of the mean importance ratings was 1.68 (*sd* = .29). For the social studies text, the grand mean of the mean importance ratings of the highest rated 17% of text idea units was 3.59 (*sd* = .10); for the lowest rated 15% of the text idea units was 1.83 (*sd* = .31). A second reason for choosing the 15% cut-off was that the frames were estimated to represent about 20 text idea units each. The 15% cut-off for each rated group meant that about 10 idea units were used in each group of highest or lowest rated idea units. Thus, each frame represented enough idea units to include the number that the raters as a group had considered the most and the least important. For the science text, the 11 highest rated and 9 lowest rated text idea units were used; for the social studies text, the highest rated 10 and lowest rated 9 text idea units were used.

The procedure that was described earlier for the full text-based approach to frame analysis was adapted to tally the representation in teacher-constructed frames of only the highest and lowest rated text idea units in science. For the social studies frames, the data on the highest and lowest rated text idea units was selected from the data set for the full text-based analysis. The frequency and proportion of occurrence of text idea units in the frames were calculated. For each content area, six "grand proportions" were computed for the average frequency of occurrence in individual, pair, and group frames of the highest and lowest rated text units. Appendix D lists these highest and lowest rated text idea units along with descriptive statistics about their importance ratings.

Chi-square (2 X 3) tests of independence using *STAT: A Basic Statistical Service Package* (Avner, 1988) were carried out for each content area on the grand proportions of text idea units occurring in frames to determine whether there was a significant dependence between level of *text importance* (the presence of the highest and lowest rated text units) and type of *teacher work unit* (individual, pair, or group). Chi-square (2 X 2) tests of independence were also run as above, except that the pair and group data were combined into a collaborative grand proportion.

Chi-square tests for expectation of equal likelihood were also calculated by hand for each content area. These tests were carried out in order to determine whether there was a significant difference between the observed chi-square statistic and the expected chi-square statistic, the latter based upon the expectation that the grand proportion for the highest rated text idea units would be equal to the grand proportion of the lowest rated text idea units.

4. What Are Some of the Teacher Concerns, Decisions, and Difficulties Related to Framing Processes?

4A. Individual framing questionnaire. Teacher responses to four of the items (Numbers 1, 2, 6, and 7 of Appendix C) about making frames were analyzed using the statistical routines with the SYSTAT software developed by Wilkinson (1988). A mixed analysis of variance (ANOVA) was run for each of the response items (dependent variables). *Order* of framing task (science text first or social studies text first) was the between-subjects treatment that was confounded with teacher groups. *Content area* (science text or social studies text) was the within-subjects treatment. The analyses for the main effect of *content area* and the *order* by *content area* interaction were free from confounding. Responses to the other three items on the questionnaire were tallied and summarized.

4B. Audiotape transcripts. The tape recordings of teacher talk were transcribed and analyzed for topic patterns and for teacher observations concerning the framing process. All of the transcripts were read twice. During the

first reading of the set of transcripts, which included viewing the individual and collaborative frames of the members of each collaborative session, the first author made a list of the topics that the teachers talked about while working collaboratively. In this manner, 22 major topics were distinguished, and 5 of these were divided into subtopics, making a total of 28 topics. During the second reading, the occurrences of the topics in the pair and group discussions were tallied. Some representative teacher comments on the most prevalent topics and a variety of teacher comments on the framing process were also noted.

Results and Discussion

The results are first discussed according to each research question. Later in the report, the major findings from these questions are interrelated in the "General Discussion and Concluding Remarks."

1. How Can Instructional Frames Be Described?

The answer to this question is based heavily on the results and discussions connected with the second and third research questions in this report. Therefore, the results and discussion of the first research question will be deferred until the "General Discussion and Concluding Remarks" section. At that time, the relative strengths and weaknesses of the frame-based and text-based approaches to frame analysis will be explained. In short, the frame-based approach yielded more precise descriptions than did the text-based approach. The LCP analysis in the frame-based approach captured representations of both fragments of single idea units and condensations of several idea units. The text-based approach, however, was limited by an inflexible unit of analysis, the idea unit. On the other hand, analysis based upon this unit was useful mainly in determining the representation in frames of the most or least important textual information.

2. How Similar Were the Teacher-Constructed Frames?

2A. Types and basic organization. Table 2 indicates the distribution of frames according to their levels of structure (primary and secondary frames) and types of representation. Teachers used a variety of frame types and organizational patterns to represent the science lesson on conifers. In general, two patterns appear to predominate about equally among frames in all three teacher works units: Two primary frames (one description and one explanation) or one primary description frame with one secondary explanation frame. These two patterns account for 70% (19 of 27) of the Individual frames, 86% (6 of 7) of the Pair frames, and 100% (2 of 2) of the Group frames. In contrast to the science frames, the social studies frames were composed primarily of one primary explanation frame with no secondary frame. This type of frame accounted for 74% (20 of 27) of the Individual frames, 100% (6 of 6) of the Pair frames, and 50% (1 of 2) of the Group frames.

[Insert Table 2 about here.]

With respect to framing the science text, the individual teachers as well as the collaborative work units were about equally divided on the issue whether to make two primary frames or one primary frame with one secondary frame. What implications do these alternatives have for instruction? Put simply, two primary frames imply two separate topics; one primary frame with one or more secondary frames implies one main topic with integrated components. This latter structure seems more consistent with the text macrostructure in the lesson "Cone-Bearing Plants," where text macrostructure is revealed primarily by the lesson's title and the two internal bold-faced headings. Students might be more likely to integrate information on conifers if they have been presented with "kinds" and "life cycle" as *two related parts* of the topic of cone-bearing plants *rather than* as *two independent topics* on trees, which two primary frames might imply.

The teachers using two primary frames may not have wished to separate the topics, but may have inadvertently done so because they found the 8 1/2 x 11-inch paper constraining. (During the experimental framing, several teachers asked if they could use more than one sheet for each framing task.) This constraint of the framing medium was apparently a major motivation behind the development of the "stacked k-maps" (Rewey et al. 1990,

pp. 3-4), which college students developed as "text substitutes." This observation gives one pause to consider whether our teachers had in mind to provide students with enough detail in the frames so that they could be substituted for the text in assignments such as studying for an exam or in writing an essay on the lesson. (In the experiment, teachers were not given explicit directions concerning the purpose of the frames they were constructing although the pre-framing presentation and the choice of fourth-grade text strongly implied an instructional purpose.) Regardless of the purposes that they may have had in mind for their frames on conifers, many teachers chose not to make *explicit* connections between the two parts of their framing representation if it involved using more than one sheet of paper.

2B. Structure and content of frames: LCP units. The upper box of Table 3 shows the average number of LCP units that were coded from individual, pair, and group frames on science and social studies texts. On the whole, teacher frames represented the lesson on cone-bearing plants with about 30 to 35 LCPs and the social studies lesson on the drought in England and Wales with about 25 to 30 LCP units. These LCP unit averages roughly correspond to about half the text idea units of each lesson. (The lower boxes in Table 3 are discussed later with the results of the third research question).

[Insert Table 3 about here.]

Was there a core of concepts that occurred in most of the teachers' frames? The LCP-frequency data on all the frames provide the basis for an answer. In the 36 science frames, only five LCPs occurred in 67% or more of the teacher-constructed frames. These LCPs included the text section heading "Life Cycle of Conifers" and statements identifying needles and tree shape as characteristics of conifers and naming the two kinds of cones, male and female. Whereas these five LCP units contain at least several main text ideas, the five LCPs do not suffice to create a coherent core of meaning about cone-bearing plants. In the social studies text, there was only one concept that occurred in at least 67% of the frames: *Problem*, as a superordinate category. The next most common LCP unit occurred in 54% of the frames, the linked concepts on the loss of crops and the rise in vegetable prices. Thus, especially in the social studies area, there was no meaningful core of text ideas that formed the foundation of most of the teacher-constructed frames.

What happened to two prominent elements of the science text macrostructure, *Cone-Bearing Plants* and *Kinds of Conifers*? Both of these explicit category labels had attractive implicit alternatives: *Conifers* and *Characteristics of Conifers*, respectively. For example, of the 27 individual frames, *Conifers* appears as a superordinate category label in 14 frames whereas *Cone-Bearing Plants* serves the same function in 13 frames. Similarly, *Kinds of Conifers* appears in 14 individual frames whereas *Characteristics of Conifers* appears in 11 frames. Considering instructional implications, a teacher may be faced with a difficult choice in making a frame. If the teacher decides to use a different label from the text, then to avoid student confusion, the teacher may have to translate explicitly the text terms into frame labels. Thus, students would have yet another piece of information to try to organize and remember.

Even though the problem of choosing the best category labels can be a difficult one, the problem here becomes more complicated upon a close examination of the text. The section "Kinds of Conifers" begins with this topic sentence, "Conifers differ from each other in several ways" (Barman et al., 1989, p. 48). In light of this topic sentence, the use of *kinds* as a category label makes sense. The section is primarily about the ways that conifers differ from each other. Only at the end of the section are specific examples of different kinds of trees alluded to in several pictures. To what extent did the teachers make use of this part of the lesson's macrostructure that focuses on "differences"? "Differences" among conifers appears as a category of information in only three individual frames, two pair frames, and in no group frames that were constructed by teachers.

In contrast to the teachers' frames, the textbook publisher's frame emphasizes the differences among conifers. The Addison-Wesley textbook (Barman et al., 1989) has a booklet of frames that supplements the text, *Addison-Wesley Science: Idea Maps, Level 4* (Barman, DiSpezio, Guthrie, Leyden, Mercier, Ostlund, & Armbruster, 1989). The publisher's frame for this lesson is reproduced with permission as Figure 8. The publisher's frame includes

Similarities and *Differences* as divisions of a major frame category *Characteristics*, which in turn is one of two divisions of the superordinate category (and lesson title) *Cone-Bearing Plants*. It is interesting to note that the publisher's frame uses *Characteristics* for a label, rather than *Kinds*. However, in this frame, *characteristics* seems appropriate. The publisher's frame states that *different* shapes and *different* sizes are characteristics of conifers. In most of the teachers' frames, however, size and shape were named as characteristics. Whereas "different sizes" may be a distinguishing characteristic, size alone is not. Furthermore, in the publisher's frame the phrase *of Conifers* is not connected with *Characteristics* as was the case in many teacher-constructed frames. In the publisher's frame there has been a subtle substitution of *Characteristics* for *Kinds*. As has been mentioned already, in many of the teachers' frames, there was a rather obvious substitution of the category label *Characteristics of Conifers* for the lesson heading "Kinds of Conifers." Perhaps less student confusion would result from the publisher's careful use of these terms than from the more obvious substitutions of teacher terms for text terms.

[Insert Figure 8 about here.]

2C. Detailed LCP analysis: Selected concepts. For selected concepts, frames were analyzed for differences in structure, completeness of information, and accuracy. (Examples of frame parts and LCP codings were presented in Figures 5 and 6.) The results of this analysis are presented in Tables 4-7, with Tables 4-6 referring to the science frames and Table 7 to the social studies frames. In each of these tables, the *n* represents the raw number total upon which the proportions in each row were determined. For example, in Table 4 the first row of data shows that in the 23 frames made by individual teachers that had *size* (of conifers) as a category label, .43 had an explicit structure. Note that 23, not 27, was used as the basis of 100%.

[Insert Table 4 about here.]

In Table 4, the "other" column is a combination of the *general* and *inaccurate* categories. Of principal interest here are the differences among explicit, implicit, and any other structures used to represent text concepts in frames. Furthermore, *within* each concept category, incomplete information was ignored, and the highest tally of subordinate concepts was used. For example, for the category *shape*, consider the number of frames in which the explicit structure for individual frames was tallied: *round* (14), *triangle* (14), and *varied* (8). These differences were ignored (*only* in this analysis!); thus, conifer shape was represented explicitly in .67 (14 of 21) of the individual frames that represented conifer shape.

The selected concepts in Table 4 were popular, each one occurring in at least 80% of the frames. Please recall that for the analysis of structure and content (2B), single LCP units were the basis for computing overall proportional occurrence in frames. These proportions were used to discuss the possibility of a "core of concepts" present in at least 67% of the frames. For example, implicit, incomplete or inaccurate versions of LCP units on size of conifers were considered as *separate* units from the versions that were explicit, complete, *and* correct. In the present analysis, however, the *group* of LCP units representing *size* occurred in 83% (30 of 36) of the frames.

For the concepts presented in Table 4, recall that incomplete, subordinate information *within* a category was ignored; only the *highest* LCP tally within a category (like size) was used. For such popular concepts, the low levels of explicitness may be surprising. The upper part of the table refers to concepts appearing in "Kinds of Conifers"; only 2 of 15 possible proportions (five concept categories each represented in three teacher work unit categories) exceeded .50 for explicitness. The proportions in the lower part of the table are only slightly more encouraging, with 4 of 9 possible proportions exceeding 50% in the *explicit* column. *Thus, the representation of most of these concepts was not explicit.* The failure to use explicit category labels in teacher frames may result in students' making faulty or misleading inferences about the concepts or the relationships that connect them in the frame or the text.

Table 5 presents some of the information that was ignored in Table 4. The focus is on the completeness of subordinate information *within* a concept category. Differences among structures and in accuracy, which were presented in Table 4, are ignored in Table 5. The upper part of the table shows that most of the frames were relatively complete in their representations of information within each chosen category. Usually, incompleteness resulted from some teacher's failure to include in the frames some indefinite classifications from the text, such as the *varied* category of conifer *shape* and the *several sides* category of *needle shape*.

[Insert Table 5 about here.]

Table 5 shows that, regardless of how they represented the "Life Cycle of a Conifer," *most teacher frames* did not represent the full life cycle. The text may be part of the problem here. The first paragraph of the section gives a three-step summary of the life cycle that starts with a seed. The second and third paragraphs discuss a sequence that begins with the production of pollen by the male cone and ends with a new tree growing from a seed. At the bottom of the same page of text is a graphic inset, "How Conifer Seeds Develop." This diagram has four numbered steps, starting with the male cone producing pollen and ending with the cones opening to release the ripe seeds. Thus, in the text, three separate but overlapping sequences are presented. There is *no* language in the text that attempts to integrate these three versions of the life cycle. Here is a case of "inconsiderate text" (Armbruster, 1984). Although a short summary initiates the discussion of the life cycle, there is no transition linking it to the second and third paragraphs on pollen production. There are no references in the text to the graphic inset. We think that the teachers were confused by this text; one can imagine how an inexperienced reader might react to it!

Table 6 shows that teachers were relatively accurate with respect to categories of information on the kinds of conifers. One exception to this was the inclusion of *tall* and *short/low/shrub* as shapes rather than sizes. Here is the way the information is presented in the text:

> Conifers differ from each other in several ways. Some are very tall trees. Others are shrubs that grow close to the ground. Conifers have many different shapes. Some are round and some have a triangle shape. Still others have no particular shape. (Barman et al., 1989, p. 48)

This section of text seems to distinguish height from shape, yet no explicit superordinate term for height or size is stated. Another problem was the way that teachers condensed "no particular shape." Some of them successfully produced synonyms like *varied* or *irregular*, but others came up with *no shape* (an impossibility for a tree). Some of these inaccuracies present in individual teacher frames persisted in collaborative work. The lower part of Table 6 presents the overall level of accuracy for all of the LCP units concerning the life cycle of a conifer. The percentage of accuracy seems relatively high, but one expects excellence in the form of clear communication and accurate information when one is considering the education of children.

[Insert Table 6 about here.]

For the social studies frames, the causal relationships involving the conditions and effects of the drought in England and Wales in early 1976 were analyzed. These relationships were presented in the Problem half of the teacher frames presented in Figures 4 and 6. These LCP groups are listed in the upper half of Table 7. The *n* refers to sum of the tallies of the three different ways that the concepts were linked in each pair; the three ways that they were linked are represented by the Link codes, *5*, *2-5*, and *3-5*. These LCP groups have been coded *1-8* for use in the lower half of the table.

[Insert Table 7 about here.]

These eight LCP groups represent concepts that appeared in many of the teacher frames. All but Number 7 occurred in at least half of the 35 social studies frames. A perusal of the column "Complete and Accurate" reveals that only about half of the individual and group frames contained LCP versions that were complete and

accurate. The pair frames, in contrast, had perfect ratings on seven out of the eight LCP categories. An examination of the rows indicates that the incomplete versions of the relationship were more common that the inaccurate versions. An example of the incomplete version was presented in Figure 6 where the causes and effects were listed rather than connected in a meaningful way. In other frames inaccurate causal relationships were indicated by arrows, such as those connecting "cows not giving milk" to "loss of crops" or the presence of "rats and insects" to the "reservoirs drying up."

Whereas the latter mistakes were infrequent and most likely were oversights by individual framers, incomplete versions occurred with about the same frequency as the complete versions. Perhaps the incomplete versions resulted from poor reading comprehension by the project teachers. Or perhaps they did not have enough time to reflect on the text before beginning the framing task, which was unfamiliar to most of them. Although either or both of these explanations could account for incomplete versions, the high proportion of incomplete versions may have resulted from the way that the text was written. The teacher frame in Figure 6 is relatively faithful to the section of text it represents. Over three paragraphs of the social studies lesson, the first author identified nine causal relationships. Only one of them was explicitly signaled (with *because*). Of the 16 sentences in this section, only one has a complex structure. The other 15 sentences are simple in structure, and most of them contain only half of what could be identified as LCPs. For example, these four successive sentences appear in this section of the lesson: "Without water, crops were lost. The price of vegetables rose. Trees began to die. Forest fires became a great danger" (Parramore & D'Amelio, 1979, pp. 123-124). Because of the way that the text was written, the reader must infer all but one of the complex causal relationships that are implied by the sequence of topics. Here, lack of signaling created a problem of inconsiderate text; a serious problem for adult readers and teachers is likely to result in poor comprehension by the young readers for whom the text is intended.

Considering the data presented in Tables 4-7, to what extent did the teacher frames have LCPs that were explicit, complete, or accurate? These four tables present 29 categories of data on groups of LCPs that represent text information. (Only 28 categories were considered for Group frames, which had no data in one category of Table 5.) The Individual frames achieved the .50 (50%) level of explicitness, completeness, or accuracy in 55% (16 of 29) of the categories, the Pair frames in 79% (23 of 29) of the categories, and the Group frames in 75% (21 of 28) of the categories.

Whereas 50% is not a high standard, 80% might be considered a more appropriate standard. This level of explicitness, completeness, or accuracy for the selected LCPs was met or exceeded in only 38% (11 of 29) of the Individual frames, 52% (15 of 29) of the Pair frames, and 36% (10 of 28) of the Group frames.

2D. Detailed analysis: Problem/Solution frame format. From the data presented on the basic type and organization of frames (2A), the frames that consisted of just one Primary Explanation frame were analyzed to determine to what extent they followed one of two standard Problem/Solution frame formats. A total of 27 frames were chosen (20 Individual, 6 Pair, 1 Group). Although teachers in the study were not instructed to use a standard format, a standard format was made available to them for use. Because the teachers were not told that they would be judged on their use of a standard format, it is not appropriate to make value judgments on the quality of the frames. The results in Table 8 primarily indicate the degree of similarity among frames of the same type and organization. An important, but secondary result concerns the relative quality of the frames.

[Insert Table 8 about here.]

Table 8 shows the results of this analysis for the criteria of completeness, explicitness, and accuracy. In Part A, diversity is indicated among teacher frames, especially among the Individual frames. Less than half of them were Explicit (using standard category labels, numbering system, and arrows) or Accurate (causal relationships precisely indicated). Only 75% were Complete (having all the information slots and labels). Because only one frame represents the Group category, Pair and Group results were combined as Collaborative results in Part B of the table.

Besides the category totals in Table 8, the frames were considered separately for standard format qualities. Only 7% (2 of 27) of Individual frames, 33% (2 of 6) of Pair frames, and 100% (1 of 1) Group frames (collaborative total = 43%, or 3 of 7) were considered to have met the criteria of *all three* qualities of completeness, explicitness, and accuracy. These totals are discouraging because the combination of all three qualities may be necessary prerequisites for clear and useful frames.

2E. Collaborative work. Among science frames, what may be a strong effect of collaborative work concerns frame type. All of the collaborative frames included description frames, and all collaborative frames except one pair included explanation frames (either as a secondary frame or as an additional primary frame). Thus, 89% of the frames produced collaboratively by teachers used one of two patterns, compared to 70% of individual frames that contained both description and explanation components. Among the social studies frames the same trend occurred, but to a lesser degree. The Explanation type of frame organized as one Primary frame was produced by 74% (20 of 27) of the teachers working alone and by 88% (7 of 8) of the teachers working collaboratively. Apparently, collaborative work eliminated some of the less frequent types of frames that had been used by individual teachers.

These social studies frames of the dominant type and organization (Explanation type, one Primary frame) were further analyzed to determine how well they followed a standard format for a Problem/Solution frame. Table 8, Part B, shows that there may have been an important effect of collaborative work. From Individual to Collaborative frames, there was a general increase in the proportions of the frames that met the criteria in three categories of frame quality: a 25% increase in Completeness, a 17% increase in Explicitness, and a 51% increase in Accuracy. For Collaborative frames, the 100% level for Completeness, and the 86% level for Accuracy are impressive. The relatively low 57% for Explicitness indicates that many of the frames substituted synonyms for standard frame category labels or omitted an arrow. Because all of the Collaborative frames were complete, one might infer that in the collaborative sessions, the teachers were attempting to follow a standard format. These results are encouraging because they indicate that the standard format became the format of choice in the collaborative sessions and that the framers, many of them novices, were able to work together fairly effectively.

Another measure of the collaborative work effect was to determine what percent of the LCP units used by teachers working collaboratively had not been used in their individual frames. In both science and social studies pair frames, 10% of the LCP units (22 of 227 and 16 of 157, respectively) had not occurred in the corresponding individual frames. These "new" LCPs were not evenly distributed, however, as they all occurred in 7 of the 13 pair frames (4 in science and 3 in social studies). In the science area, all but two of the new LCPs concerned concrete information from the text on the specific shapes and sizes of conifers and the specific characteristics of needles. Four of the LCPs occurred in two different pair frames, and the other 14 appeared once each. In the social studies area, none of the 16 new LCPs occurred more than once, but they evenly represented the gamut from superordinate frame terms and main ideas on the lessons of the drought to concrete information on local effects of the drought and on specific ways that people conserved water. Whereas the new text-based LCPs in science came almost entirely from the one section of text, "Kinds of Conifers," the new text-based LCPs in social studies had sources throughout the lesson. In all group frames, only 5% (6 of 119) of the LCP units were new, 3 in science and 3 in social studies. Each of the six LCPs occurred only once as a new LCP unit; they were a mixture of superordinate and subordinate information. One would be hard-pressed to generalize about meaningfulness of such a small number and percentage of LCP units.

Another way to detect the effects of collaboration was to see how many LCPs did not occur in collaborative frames, but that had occurred in all of the individual frames of the collaborative unit members. In all pair frames, only 7% (7 of 104) of these "common LCPs" were revised out of the collaborative frames: 8% (6 of 76) in science and 4% (1 of 27) in social studies. There did not seem to be any meaningful pattern to the LCPs that were excluded. Common LCPs were not a factor in group frames, in that within the four groups in both content areas, there were no common LCPs.

By these measures, not many "completely new" concepts with linking relationships were revised into the frames produced by teachers working collaboratively, and not many LCPs common to all individual frames were revised out of the pair frames. Indeed, a number of collaborative frames were assembled by cutting and pasting photocopied parts of two or three individual frames.

With respect to the detailed analysis of selected LCPs, which was presented in Tables 4-7, the Pair frames achieved at least the 50% level of explicitness, completeness, or accuracy of information in 79% of the concept categories and the Group frames in 75% of the categories. In comparison, the Individual frames achieved this level in 55% of the categories. The 80% level or higher was achieved by Pair frames in 52% of these same LCP categories, but Group frames attained this level in just 36% and Individual frames in 38% of the categories.

Another way of analyzing the same LCP tables is to compare Individual proportions (of explicitness, completeness, and accuracy) to the Pair and Group proportions and to note whether there is an increase, no change, or decrease between the individual and collaborative units. In the comparison of Pair and Individual frame categories there was an increase in 59%, no change in 10%, and a decrease in 31%. Thus, the work of the collaborative pair units appears to have eliminated a healthy amount of the faulty information that had been present in the individual frames. In the comparison of Group and Individual frame categories, there was an increase in 43%, no change in 11%, and a decrease in 46%. Thus, the group unit seems to have been less effective than the pair unit in revising out faulty information.

In considering these results, one should keep in mind two conditions. The Group proportions that were used in the preceding discussion of Tables 4-7 are based upon only two groups in each content area. Thus, the levels of explicitness, completeness, or accuracy in each frame greatly affects the overall Group proportions. Second, for each content area, data from all of the individual frames were used. About half of the teachers who made those frames went on to work on a pair frame and the other half went on to make a group frame on the same content. Thus, this part of the analysis does not fully reflect a revision process, unlike the analysis of "new LCPs" and the "common LCPs." What the present focus does reflect is the total levels of explicitness, completeness, and accuracy for selected LCPs that were produced by three different teacher work units. As such, the collaborative pairs seemed to do the best job, but there was much room for improvement among all teacher work units.

In summary, the analysis of frames thus far reveals that most of the frames on the science text "Cone-Bearing Plants" combined two types of frames, description and explanation. In contrast, most of the social studies frames on "A Limited Resource" were of the Primary Explanation type. Differences in frame type appear to be strongly influenced by the structure of the particular text. Upon close examination of frames, important patterns of differences emerged. In general these differences can be seen according to how effective or ineffective the representation might be to a student using the frame as an aid to learning from text.

About half of the science frames used an integrated primary-secondary organization whereas the other half used two primary frames. Some frames used an explicit structure and complete, accurate information in order to represent the main text ideas and the relationships between them. On the other hand, many frames used implicit or general structural categories, lacked the full information within the designated structures, or contained information that was faulty or would likely mislead a student. These dichotomous patterns were apparent in the frames constructed by individual teachers and by teachers working collaboratively.

Although most of the social studies frames were of the Primary Explanation type, about 25% of the Individual frames were of a different type. A close examination of Primary Explanation frames revealed considerable variations upon the standard frame format, even among the teachers who were obviously trying to follow the format by using the standard layout, labels, and symbols. As with the science frames, the social studies frames showed considerable diversity in the way that the text relationships were presented. Frequently this diversity was the result of incomplete or inaccurate versions of text concepts and their relationships.

Not many "new concepts" appeared in the frames produced by collaborative sessions, but collaborative work seemed to eliminate some of the diversity and faulty representations in individual frames. The pair sessions were relatively effective in this regard, but the group sessions appeared to be only marginally effective. Passages of inconsiderate text in both lessons could account for at least some of the faulty or misleading information that appeared in teacher-constructed frames.

3. To What Extent Were Important Text Idea Units Represented in Teacher-Constructed Frames?

3A. Text-based frame analysis: Social studies. The analysis of the social studies frames was carried out in order to determine the frequency of occurrence in teachers' frames of the idea units from "A Limited Resource." The mean number of text idea units per frame was 25.0 (sd = 6.5). The means and standard deviations for the three teacher work units appear in the lower part of Table 3. This part of the table shows that the average numbers of text idea units represented in Individual, Pair, and Group frames was about the same as the number of the LCP units that were represented in each frame. The LCP units attempted to account for text-based and nontext-based information. Thus, the two systems of analysis operate differently, but produced roughly the same total units.

The tally of text idea units in this study may overrepresent the text idea units in frames. If information in a frame had as its source only a small but distinguishable part of a text idea unit, the frame was credited with representing that idea unit. This procedure seems to be a valid way to determine the representation of the text ideas, but the whole text idea unit may not be a very precise way of representing what is actually in the frame. Thus, the decision was made to terminate the text-based approach to analyzing frames and to use the text-based approach just to analyze the representation in frames of the relatively important and unimportant information from the text lessons.

3B. Analysis of highest rated and lowest rated text idea units. For each content area, chi-square tests of independence were run on the grand proportions of the frequencies of representation in frames of the highest rated and lowest rated test idea units. These grand proportions are printed in Table 9 (as well as in Appendix D). All of the tests of independence proved to be insignificant. In the science area, the 2 X 3 test resulted in X^2 (2) = 2.14, p = .343; for the 2 X 2 test, X^2 (1) = .144, p = .705. In the social studies area, the 2 X 3 test produced X^2 (2) = 3.59, p = .17; for the 2 X 2 test, X^2 (1) = .014, p = .91. Thus, one can assume that there was no association in the general population between the type of teacher work unit and the rated importance level of the text.

[Insert Table 9 about here.]

Also given in Table 9 are the grand proportions for the representation in *all frames* of the highest and lowest rated text idea units. These grand proportions were tested against the likelihood of equal expectations. For science, the test results were nonsignificant, X^2 (1) = .690, $p < .50$. For social studies, the test produced a significant result: X^2 (1) = 7.56, $p < .01$. Thus, there was very little likelihood that the presence in the teacher frames of these proportions of highest rated and lowest rated idea units from the social studies text could have happened by chance.

How can one account for the relative differences between the science and social studies frames with respect to the inclusion of important and unimportant information from text? Several explanations are possible: that the teachers were not skillful at selecting the most important information in science but were in social studies, that the nature of texts is idiosyncratic, and that framing text involves some criteria for importance that are different from those used by the raters of text idea units.

The first possibility cannot be ruled out, since the teachers' aptitudes for reading science and social studies texts were not determined by any measure. Second, the texts themselves differ in structure and content. The science text has an introduction, which gives some interesting facts about conifers but also made important comparisons

between flowering and cone-bearing plants. The introduction and two major sections of the science lesson have at least two different expository structures (comparison/contrast and temporal sequence). On the other hand, the social studies lesson is structured around just a temporal sequence with explanations provided as the events of the drought years unfolded. Thus, with its complexity and quantity of information, the science text simply may not contain very much information that was unimportant.

Third, framing text certainly involves choosing the main ideas and some of the most important subordinate information from the text. These criteria also apply to selecting material for a summary. In addition, framing might involve choosing key details in order to develop a hierarchical relationship or to create a causal pair. For example, this idea unit was represented in 33 of the 35 teacher frames in social studies: "Some people watered their gardens with used water from bathtubs and kitchen sinks" (Parramore & D'Amelio, 1979, p. 124). This idea unit was also rated in the *lowest* 15% by the graduate students who rated the text idea units. In many teacher frames, this idea unit appeared as part of a list of examples of water conservation methods that were used during the drought. This idea unit is probably not in itself essential to the development of the thesis of the text lesson. However, in teacher frames this idea perhaps served to illustrate in a way that fourth graders could easily visualize just how the abstract idea of saving water can apply directly to everyone.

In sum, the text-based approach to analyzing frames was not found to be a satisfactory way to account for the information in frames, but this method was very useful in determining the representation in frames of the most and least important information from text, as judged by independent raters. There were some differences between what the text raters judged to be important and what the teachers included in their frames. The idiosyncratic nature of text and some differences in the importance criteria used by text raters and text framers are factors to be considered in judging the appropriateness of particular information in instructional frames.

4. What Are Some of the Teacher Concerns, Decisions, and Difficulties Related to Framing Processes?

4A. Individual framing questionnaires. Questionnaire Items 1, 2, 6, and 7 were dependent variables in the analyses of variance tests. (See Appendix C for a copy of the questionnaire.) None of the statistical tests on the four dependent variables proved significant, either for the main effects or the interactions.

Table 10 contains the means and standard deviations of the four dependent variables for the two content areas; grand means for the four responses are also included. The means should be interpreted on the basis of a 7-point Likert scale. The means for all the questionnaire items ranged between about 3 and 5. The 7-point scale roughly measures a continuum between two extreme opinions. The midpoint of the scale at 4.0 indicates a neutral opinion. Therefore, the obtained means do not indicate that the typical response to any item was very strong. Of some interest, though, is the mean for Item 6. The teachers felt slightly more confident than neutral that their frames faithfully represented the text.

[Insert Table 10 about here.]

Another item on the questionnaire asked the teachers to rank order three sources of influence on making their frames. The item was discarded because of incomplete data from new project members. However, the experienced members of the Framing Project *unanimously* ranked "prior experience with framing" as the most important influence, ahead of knowledge of subject matter topic and the text.

Two open-ended items asked the teachers to state what they felt to be the hardest and easiest aspects of making the frame. The results are based upon the 27 questionnaires that teachers completed after framing the science text and the 27 questionnaires that they completed after framing the social studies text. The order of framing tasks was ignored in this part of the analysis. A number of teachers did not respond to one or more of the items. Only the most common comments are reported, unless an aspect of framing was mentioned as being the hardest by someone and as the easiest by someone else. These results are presented in Table 11.

[Insert Table 11 about here.]

For the science text, the hardest aspect of framing that was mentioned by the most teachers was deciding the frame type or kind (eight teacher responses), but this aspect of framing was considered by two other teachers to be the easiest aspect. The most popular opinion on the easiest aspect of framing the science text was using a flow chart organization, which probably referred to the representation in teacher frames of the text material on conifer life cycle or seed production. For the social studies text, all of the aspects that were mentioned most frequently were considered by some teachers to be the hardest aspects, but by others to be the easiest. This situation suggests that framing texts is a complex process, which may be very difficult to learn and teach. What may be difficult for some to do may be very easy for others to do.

Part of the complexity of the framing process, of course, can be related to the high degree of variability of texts. As shown in Table 11, only deciding frame type, determining text organization, and selecting text information appear as popular responses in *both* the science and social studies framing questionnaires. Of course, these three dimensions are among the few truly essential aspects of framing. On the other hand, deciding the number of frames presented a major difficulty in the science text, but was not mentioned by any teacher on the social studies questionnaire. With the social studies text, organizing text ideas was the difficulty mentioned by the most teachers. Although text organization was mentioned by three science text framers as being the most difficult, one could argue that *determining* the organization of the science text was a subtly but significantly different task from *organizing* the ideas in the social studies text. The difference in the emphasis of these comments may reflect differences in the texts. The lesson "Cone-Bearing Plants" uses bold-faced headings to signal the top-level structure of the text, but the lesson "England and Wales in 1976" does not use any such headings to divide the lesson.

4B. Audiotape transcripts. Analyses of the audiotape transcripts of the teachers' collaborative framing revealed what topics were the most popular and what elements of the framing process appeared to be the most important. This discussion of teacher talk generally follows the order of information presented in Table 12: A brief review is presented of the guidelines that we provided for teachers to use in collaborative work; then the selected topics of teacher talk *in both content areas* are illustrated with teacher comments from the audiotape transcripts; finally, topics and comments that occurred in *only one* of the content areas are discussed, first in the science area, then in social studies. Topics were selected for their relevance to the framing process and for their frequency of mention.

[Insert Table 12 about here.]

Table 12 provides an overview of the discussions that took place among teachers engaged in collaborative work on framing the science or social studies text. The preliminary note provides the context for the data presented in the main part of the table. The guidelines and checklist for collaborative work gave the teachers a flexible structure for their discussions and framing task. As indicated by the note, we wanted teachers to reconsider the text and their individually produced frames in order to make a collaborative frame.

Below the note to Table 12 are listed 15 topics of teachers' talk. The topics that were common to both content areas are ordered, not by popularity, but rather by clusters of related topics: students, text-to-frame issues, and experiences with framing. A perusal of the topics shows that there is some overlap between the guidelines checklist and the topics that were discussed. For example, the "format of collaborative frame" appears on the checklist and the main part of the table. Whereas some teachers explicitly talked about frame formats, other teachers dealt implicitly with this topic, which for them was subsumed under a group of other topics, principally "Type of Frame" and "Number of Frames."

Some of the differences in topic popularity were reflected in part by the content area in which the teachers were working. Table 12 also includes by content area the collaborative groups that took up the particular topics. For example, all eight social studies sessions explicitly included discussion of "Graphic format of frame," but only five

of the nine science sessions included this topic. However, more science than social studies sessions included the related topics ("Type of Frame" and "Number of Frames"). An X in the last column simply indicates those subjects that were discussed in both science and social studies sessions.

In summary, all of the teacher talk emphasized the relationship between text and frame in terms of the structure and content of the frames that the teachers were constructing. Although the teachers did not slavishly follow the checklist, all groups had checked off virtually all of the topics on their lists that they handed in with their completed collaborative frames.

Topics of Teacher Talk

Students

Perhaps the most significant topic, "Students" was the one topic discussed in all 17 collaborative sessions. Although teachers were not asked by us to discuss their students, all teachers considered how their frames might affect their students. For example, early in their discussion, the teachers in Pair 1 (science) exchanged opinions on student reaction to frames:

> Teacher 1A: "I think with the kids I'd want it all on one [frame]. Would you? . . . "
>
> Teacher 1B: ". . . my type of students . . . . This is too many ideas for them to get at once."

This concern for student processing of information was very common, as the need for simplicity in frames was brought up in 13 out of 17 collaborative sessions.

Students fill out frame. Having students make or complete the frames was a topic considered in 12 of the collaborative sessions. A teacher in Group A (science) objected to giving kids "something else to memorize." Group D (science) discussed the purpose of the collaborative frame with one teacher, saying that a filled-in frame would be fine for a "teacher model," but "if you're going to be using this for students, then none of this [information] would be in it. You'd just have your [blank] lines." Still another teacher stated how she had students work in cooperative groups in order to complete frames: "I try to put a high, medium, and low child together to start off with . . . . And then, I would give them the characteristics and let them fill in the descriptions."

The next two comments were made also by experienced framing teachers. Their students' responses to framing have, in turn, influenced the way that teachers have constructed frames. In these cases, the teachers are referring to students filling out frames that have been made using the standard Problem/Solution frame format.

> See, my kids are so used to looking at the end of the text for the results, because they've learned at this point that within the text that's what the textbook writers tend to do. At the very end, they give you your finalizing, little concluding statements that draw it all together. So they're really getting good at zeroing in on where you'll find the results part of your frame.
>
> The pattern is set, you stay with it, and they [students] can pull out the main information [from the text]. I used to think that if I didn't change it they would get bored. But you know, they don't. In fact, they really do a lot better when they know what to expect.

These last two comments indicate how the teachers' concern for their students led them to certain decisions about frame format and about the students' activity of completing the frame with information from the text.

Clarity of presentation in frame. Teachers were concerned about the clarity of information being presented in the collaborative frame. Pair 8 (social studies) tried to avoid wordiness in the frame. Often, spatial issues of

framing were more deeply considered than verbal issues. Different members of Group A (science) contributed these observations: "I think the layout's real important so that it's easy to read" and "I thought of what my kids could handle, and mine [my frame] was too bunched together." Pair 9 (social studies) also revised a cluttered representation into a clearer one: "We decided to go from this kind of thing [format] into more of a listing thing because we felt this was too crowded, . . . and they [students] might be more comfortable with this [chart]." A social studies group (C) preserved an obvious amount of white space on the page in order to emphasize the connection between two separately boxed ideas.

Most of the teachers in pairs and groups hadn't known each other prior to the experimental setting and were currently teaching students that the teachers perceived as being at different ability levels (even though the students were frequently at the same grade level at different schools). Thus, teachers' decisions about making frames were influenced somewhat by the students that teachers imagined might use the frames. As one teacher commented to her pair partner, "You tend to think of how you would use it [a frame] in your classroom . . . . I may have a totally different goal [from yours]. It's hard to know out of context what you want to emphasize."

A related concern was how a teacher might make frames for use with different grade levels of students or for use with students who were new or experienced with framing. A teacher in Group B (social studies) addressed some of these considerations:

> Between fourth, fifth, and sixth grade you have a range of higher level thinking and where they are in the process of learning how to use this [a frame]. A frame you give them in the beginning is not necessarily the same kind you would give them after they are familiar with them.

Thus, the teachers related nearly every key decision to an assumed purpose of making the frame, that is, for use with specific groups of students whom the teachers perceived as having particular needs that varied from student group to student group. Keeping students foremost in their minds, many of the teachers made frames for students to complete with text information. Thus, the choice of frame format and the language of presentation were issues that were connected to students as well as to the text that the teachers were representing in frames.

Text-to-Frame Issues

Individual frames, same information. Prior to making a collaborative frame, the teachers in most sessions compared their individual frames and then talked about the relationship of the text to the frames. As they compared their individual frames, teachers discovered that the information that they contained was essentially the same. A member of a teacher pair working on a science frame stated, "All the information is the same, we just put it into different formats." This comment was echoed by a teacher pair working in the social studies area: "'It's amazing how different everybody's [frame] looks.' . . . 'It is. And the information still comes out basically the same.'" Observations similar to these were made during 13 collaborative sessions in all.

Text organization and type of frame. After sharing and comparing the information in their individual frames, teachers in most of the collaborative sessions considered the potential structures for their collaborative frames. Most of the sessions on science text involved considerations of the type and number of frames to use, but most of the sessions on social studies text involved considerations of graphic format.

These different emphases are probably a reflection of the different top-level structures contained in the two selections of experimental text. The conifer lesson was divided by bold-faced headings into introductory comments and two major subsections. One of these, "Life Cycle of a Conifer," was most conducive to an explanation frame; the other subsection, "Kinds of Conifers" was most conducive to a description frame. Consequently, the issues of type and number of frames became issues for virtually all of the teachers working collaboratively on science texts and frames. On the other hand, the lesson on the water shortage in England and Wales developed a problem/solution thesis around a chronological order of events; this structure was most

conducive to an explanation frame. Only 4 of the 27 individual teachers made description frames on the social studies text, and the remaining 23 teachers made explanation frames.

One of the pairs (Number 7) working on social studies discussed the types of frames each had used individually. Each had used as a model a sample frame from the booklet *Framing Information*. (Both teachers were new to the Framing Project.)

> Teacher 7A: So you used a descriptive [frame]. I used a cause/effect . . . . I was curious as to why you used descriptive instead of cause/effect.
>
> Teacher 7B: In the article it seemed like it just sort of listed this, this, and this was caused by . . . . Everything wasn't listed all in one little spot. Like the effect on animals, talked about the cattle in the beginning, insects flying . . . so they'd almost have to reread the article maybe two or three times to get all the information out of it.

Teacher 7A went on to explain how each specific effect (of the water shortage problem) directly resulted from a specific situation, and that both were connected in the text. This pair went on to produce a collaborative frame that incorporated some Teacher 7B's suggestions for conservation into the standard Problem/Solution frame which had been produced individually by Teacher 7A. Their work was a truly collaborative effort that seemed satisfactory to them both.

Number of frames (1 vs. 2). Deciding the number of frames to make was a topic considered in all nine collaborative sessions on the science text. Pair 1 decided to use two frames, a description frame (*Characteristics of Conifers*) and an explanation frame (*Life Cycle of Conifers*). They put both frames on one page so that students wouldn't have "two [papers] to get lost." Thinking of their students, these teachers used two primary frames, instead of one, because there would be "too many ideas for them to get at once [in one frame]." Although the teachers in Pair 1 didn't want to overload their students with too much information, the two primary frames that they made were closely related in the wording of the frame titles as well as in the text.

These teachers did not discuss in detail the possibility of unifying their frames, but some of the other teachers made *Cone-Bearing Plants* a superordinate category label with *Characteristics* and *Life Cycle* as subordinate category labels. (Thus, the frame structure had one primary description frame with *Life Cycle* as a secondary frame embedded within the primary frame.) Contrasted with the two primary frames developed by teacher Pair 1, an integrated frame might allow students to chunk more easily the key information of the chapter. This issue was a difficult one for most teachers to resolve.

Graphic format of frame. This topic was taken up explicitly in more social studies sessions than in science sessions. Format was considered at two levels. The more general level sometimes involved the choice between a general cause/effect representation and the standard problem/solution format (shown previously in Figures 3 and 4). The other level involved refinements of the problem/solution format that had been used by the individual teachers. In some sessions, the teachers had not matched situations to effects in the problem half of their frames. For example, as the teachers in Pair 8 compared their individual frames, the first difference that one of them mentioned was that in her frame she had an effect that corresponded by number to each situation. Her partner responded, "Oh, that's a good idea, sure."

Group C (social studies) decided *not* to use arrows between the Actions and Results boxes, because the "general results" did not "correspond" in a one-to-one relationship to the actions. In consideration of this rationale, their frame was recoded as having an *explicit* structure. The teachers' comments on graphic format of social studies frames in general supplemented our earlier analyses on the types and structures of frames. We had been puzzled by a couple of frames that used a Problem-Action-Results structure, which was a modification of the standard problem/solution structure (Situation-Effect, Action-Results). A member of Pair 9 (and returning project member) explained why she used the modified structure: ". . . now if I were doing this at the fifth-grade level,

we use these frames all the time: Problem, Action, Results." This comment and others helped account for the similar structures of several frames that appeared to be variations on the standard structure.

Amount of detail in frame. This topic came up in 12 of the collaborative sessions. The appropriate amount of detail can vary with the purpose of the frame. One would use more detail in a frame that was a text substitute than in one which was a text supplement. Even text supplements can vary in detail with the time in the lesson that the frame is introduced (as a pre-reading organizer or as a post-reading study activity). An effective amount of detail is also somewhat influenced by considerations of the clarity and simplicity of the frame (as discussed earlier) and the demands on students' processing.

Considering amount of detail, a teacher in Group A (science) claimed that "If you get too much detail, the kids will look at it and quit." A teacher in Pair 5 (social studies) expressed a generally similar concern: "And I'm never sure quite how much detail to include in frames . . . although, I've found that the less details I include, the better my children are with it [the frame]." Problems can arise, however, if not enough detail is included in a frame. A couple of social studies pairs considered including just main idea statements for water conservation measures, such as reusing waste water. However, they decided to avoid potential problems with the word *waste* by including the more detailed notions of reusing dish and bath water. Thus, judging the best amount of detail to provide in a frame can be a complex decision.

Experiences with Framing

Prior experience with framing was brought up in 9 of the 17 sessions. (Discussed earlier in this report were comments on framing experiences that some teachers made in connection with the teachers' concerns for students.) Although not studied systematically, teachers' prior experience with framing influenced the framing process in collaborative work sessions.

Perhaps the most revealing comment by a returning project member involved not teaching with frames, but rather learning to frame:

> That's something we need to stress because a lot of people are just beginning on this [framing] and they're frustrated at first. They haven't been told that you're going to be frustrated, or it's not going to be easy. 'Cause after one year and a half, I mean I worked on them for a year and I've been using them this year, and I'm still having trouble doing the framing part, setting up the orders.

Hardest part of doing this frame. The teachers also gave their opinions on what they felt was the hardest part of doing the frame. Nearly always, these comments occurred at the start of a collaborative session and referred to the individual frame that a teacher had made (as opposed to the collaborative project that was just beginning). Among the teachers working with the science text, four of the sessions emphasized the type and organization of the frame ("set-up"); one of these sessions also included a statement about the lack of experience. The fifth session included comments about the amount of information in the text as being the hardest part of the framing task. Among the teachers working with social studies text, two sessions included specific references to the "set-up" of the frame, one had statements about how much detail to include, and one pair agonized over how to make a collaborative frame different from an individual frame. These comments correspond generally to the information that teachers provided on the Individual Framing Questionnaires (discussed earlier in this report). Deciding the type and graphic layout of the frame and selecting the appropriate text information for the frame were mentioned by the most teachers as being the most difficult aspects of framing regardless of the text (refer to Table 11).

Which text was easier to frame? This topic came up briefly in three of the group sessions. In Group A (science) several teachers stated that the headings in the science text made it easier than the social studies text to frame. On the other hand, in Group D (science), two teachers claimed that the science text was harder to frame than

the social studies text. In Group C (social studies) one teacher felt that the texts were equally challenging, but the rest stated that the science text was easier to frame than the social studies lesson.

Related to the topic of difficulty was the question of coping with difficulty. In Group A (science) a teacher new to the Framing Project felt "a little nervous," so she began the framing task by underlining the text, in the same way that she "had studied in college." One of the new project members in Group C (social studies) stated that the obvious organization (headings) of the science text made her feel "more secure"; this teacher also began the framing task, not by visualizing a frame, but by underlining the text. With the social studies text, however, she took notes instead of underlining. In the same group another new member said that she just looked back through the text and started to make a frame. A third teacher underlined the text and made marginal notes before making the frame. An experienced framer of this group commented that she was now used to looking for main ideas to frame as she read the text.

In sum, teacher talk in collaborative pairs and groups focused on a core of common topics. "Students" was the most popular topic, which teachers connected to most of the other areas of concern, from global issues of frame type, number, and graphic format, to local issues of which details and how many of them to include in the frame. While comparing individual frames and constructing their collaborative frames, teachers revealed key factors about their prior framing experience and about the ways that they could use framing or are using framing with their current students. Some of their talk directly supplemented our earlier analysis of their frames, leading to several appropriate revisions in the coding of single frames. This increased accuracy of analysis contributed to some refinements of our understanding of the frames and the framing process.

Topics of Teacher Talk in Science

The topic of prior knowledge as a source of framing information came up in five of the science sessions. In four of the sessions these comments concerned details about specific kinds of trees, such as the type of needles that a pine has. One teacher called this her "backyard knowledge." In two of the sessions, teachers stated that they were unsure whether or not they personally had any prior knowledge in science . . . .

Teacher talk sometimes also revealed different, even opposing, attitudes toward the content in a section of text. On the topic of the life cycle of a conifer, for instance, Pair 3 decided that it was "not necessary" to frame this section because it was represented by a graphic and text in the book. In contrast, members of Pair 10 agreed that the life cycle was a "big thing," the "tough part of the chapter"; thus, this pair featured the life cycle in making a collaborative frame.

The frame analysis using LCP units (reported earlier) highlighted many areas of interest. Two areas of concern were the decisions about category labels and the persistence in collaborative frames of inaccurate information that had appeared in the frames made by some of the individual members of the collaborative units. Pair 1 and Group D discussed the label *Kinds of Conifers*. Pair 1 directly confronted the choice between *kinds* and *characteristics* to represent the text. After listing some information, one of the teachers asked, "Did we really list kinds?" The other teacher said that they hadn't. Then they decided that what they had really listed were the characteristics of conifers, not the kinds of conifers. At this point, Pair 1 gave no indication of checking with the text in order to discover why the text had used the heading "Kinds of Conifers." Group D's situation was somewhat different from that of Pair 1. Group D explicitly discussed *Kinds* as a category label. However, later on, they constructed their frame by cutting and pasting parts of the individual frames that they had preferred. Apparently, they preferred the details in one teacher's frame that used *Characteristics* not *Kinds* as a category label. Thus, Group D seemed to bring in the idea label along with the details; no one mentioned anything about this category label change that was built into the final frame.

This same process could also account for the inaccurate information that appeared in the frame made by Group D. One of the category labels listed under *Characteristics* was *Conifer Shapes*. *Tall* and *short* were included in this category, along with *round*, *triangular*, and *irregular*. Although the differences between *large* and *tall* were

discussed explicitly, no one mentioned the inaccuracy (or at least imprecision) of including *tall* in the shape category. Similarly, when a teacher in Pair 1 or Pair 10 used the words *no shape* instead of *no particular shape*, the partner did not discuss the problem of accuracy or precision.

Group D expressed an emphasis not discussed by other teacher collaborative work units. Some members of Group D insisted that the group frame be constructed on the basis of the text questions. The questions under consideration were the *post-text* adjunct questions that reviewed the whole lesson on conifers. These teachers raised the issue of the goals of instruction. In general, some teachers may feel that the post-text questions are supplements to learning, but others may feel that answering these adjunct questions is the goal of reading. In developing these opinions, teachers might be influenced by a text publisher's emphasis of these questions in the teacher's edition of the text. Teachers may also be working within prescriptive curricular policies set by the school principal or the school district administrators, who may insist that the text materials be followed rigorously and routinely.

Although these topics and issues came up in the science text sessions, most of the concerns involving frames and texts could apply to framing any number of texts in the content areas. Concerns about background knowledge or text-adjunct questions and decisions about category labels in frames are not limited to a particular content area.

Topics of Teacher Talk in Social Studies

Teachers in several sessions expressed concern about the appropriate prose unit to use in a frame--sentence or phrase. The members of Pair 4 agreed to revise their collaborative frame in order to "put it into sentences . . . since we're trying to teach the kids to use sentences all the time." In contrast, Pairs 5 and 8 came independently to the conclusion to use phrases or individual words so that their frames would not become "too wordy." Although Pairs 5 and 8 took the opposite approach from Pair 4, teachers in Pairs 4 and 5 acknowledged a common problem that students had with the use of different prose structures in different situations. A teacher in Pair 5 stated that in making frames with her regular class, she used " . . . two, three words, I don't want a complete sentence. And I have some [students] that can't understand that either." Just as sentence outlines and topic outlines are appropriate for different purposes, perhaps frames written in sentences might be more appropriate for some purposes (or perhaps with some students), but frames written in phrases might be more appropriate when succinctness is of primary importance to teachers.

As noted earlier, the Problem/Solution frame format is more prescriptive than the typical description format (branching tree or wheel) or generic explanation frame (chain). These latter formats do not specify as limiting a rhetorical relationship as the two-tiered Problem/Solution frame format does. This format is a very explicit variation of the generic chain format used in many types of explanation frames, which can represent simple chronology or the steps in a process as well as cause/effect relationships. Thus, the challenge arose, in a particularly acute way for some of the new teachers, of fitting the social studies text to the standard problem/solution format. A teacher in Group B stated, "It was hard for me to fit into one of the frames they had because they had a problem and it affected a lot of things." A member of a pair said that the hardest thing for her was to find more than the one problem of "NO WATER." Finally, she decided to fill the "situation box" with background details on the drought as it built up from 1974 through early 1976. For a new project member in Group C, the format challenge seemed to strain the limits of her ability to organize the text information:

> When I read the text, I saw that [a very structured representation of text]. But when I tried to put it on paper, it didn't match up like it had when I read it . . . . And since this is the first time I've ever framed, that's why when we worked back in pairs [earlier, on the science text], I had the ideas she had, but I didn't have the graphics that she had. And that's so important because this [frame] isn't going to be that much more helpful than the text without putting it in graphic organizing.

The teachers in her group responded in a couple of ways. One teacher stated that she had felt the same way when she had started framing two years before. Another teacher commented that "the longer you do it, the better you get at it." Other teachers also stated that they had started by taking notes on the text or had used other familiar study strategies, and had not simply "plunged in" to the part of the framing process that involved the composition of the graphic format.

Although the topics of appropriate language for frames and the challenges of fitting text to a format arose in the social studies sessions, these topics could apply to other texts and to framing a systematic way of thinking about a content area.

An observation that we made informally about teacher work in both content areas was that the collaborative sessions often functioned as support groups. Returning project teachers advised new members; in all of the sessions, both new and returning teachers seemed eager to discuss the framing process and the things that they had first struggled with alone in framing the text.

General Discussion and Concluding Remarks

This study explored four research questions on teacher-constructed frames and teacher framing. The first three questions focused on developing ways to describe systematically the frames the teachers had made to represent expository text lessons.

The frame-based approach to analysis appears to have worked well in accounting for the content of frames, for the variability among frames, and for some differences among frames in completeness, explicitness, and accuracy of information. At the most global level of frame construction, frames were classified and coded by type, either as Description, Comparison/contrast, or Explanation types. In addition, frames were classified by organizational components as combinations of Primary and Secondary frames. Secondary frames were ones that were embedded in a Primary frame that encompassed all (or a discrete division) of the framed information related to a text lesson. A special format analysis was also developed for the Problem/Solution frame, which has a standard, ready-made format that was used or adapted by many teachers. At the most local level of frame construction, the Linked Concept Pair or LCP was developed as the unit of analysis. The LCP consists of two concepts that are related rhetorically to each other and are spatially connected in the frame. LCP-content analysis was applied to every unit of all 71 frames that the teachers produced individually, in groups, or in pairs. This analysis revealed considerable variability in the way that teachers represented the same text information. They also varied with respect to their levels of completeness, explicitness, and accuracy as indicated by analysis of selected LCP groups. This frame-based approach showed that, with minimal guidance in framing text, the Framing Project teachers produced frames that were generally alike in type and content, but the frames varied considerably with respect to precision and explicitness. A few frames demonstrated an integrated structure, presented explicit category labels, and contained information that was complete and accurate. Many of the frames, however, seemed to lack one or more of these elements that may be crucial for effective classroom use with students.

The text-based approach was not very sensitive for the full analysis of frames that was carried out on the social studies text. This analysis was not as precise as the comparable LCP analysis; 59 text idea units as opposed to 156 LCP units were used to analyze the frames on the drought in England and Wales in 1976. Two specific problems arose in using text idea units alone to analyze frames. First, frames contained information that was not based in the text--for example, the standard format terms or other information that teachers included from their prior knowledge of the topic. Second, teachers represented in different ways the same text information. For example, some teachers invented a very efficient gist statement that combined in one clause the information that was presented in a half dozen sentences on the background and early stages of the drought. Other teachers virtually copied this same information from the text. Still other teachers combined this same information into two or three clauses in their frames. All three ways of representing the text were equivalent with respect to text

idea units. On the other hand, the LCPs could account for these different ways of packaging the same information.

The text-based approach was very useful, however, in analyzing frames for content of selected text idea units. The text idea unit was used to analyze frames for their content of the most and least important text ideas as judged by independent raters. In the social studies area, a statistically significant difference was found between number of the highest and lowest rated text idea units that were represented in teacher-constructed frames. No such finding was observed in the science area. The idiosyncratic nature of texts was cited as a likely explanation for these different results. Texts may vary in suitability for framing and according to their relative amounts of important and trivial information. Another explanation was that the selection of text material for a frame may involve different or additional criteria that teachers used, but that were not used by the independent raters of the importance of text idea units.

As outlined above, a combination of the frame-based approach and the text-based approach appears to be the optimal way to describe frames in a systematic way. The frame-based approach would be used to describe the type, organization, and concept relationships in the frames. The text-based approach would be used just to analyze the frames for the relative importance of text idea units.

Further research in this area should, at a minimum, involve these combined analytical approaches. Analyzing frames produced by different teachers on different experimental texts from those used in the present study should result in a healthy refinement of the analytical methods. A dimension of this study should also include independent rating of the experimental texts for their suitability for framing. Another aspect of future research on teacher-constructed frames might be the inclusion of systematic instruction on how to make frames. At the very minimum, this procedure would involve giving experimental subjects lots of guided practice in framing, with special attention to clarity of presentation and to the inclusion in frames of complete, explicit, and accurate information.

In the present study, many factors could have contributed to the mixed levels of quality and thoroughness of work. At least seventeen of the teachers came to the study as novice text framers. The experimental instructions were descriptive, not prescriptive, and several teachers wrote comments or asked questions during the experiment that indicated that they were not at all confident that they were "doing it right." Furthermore, the lesson on cone-bearing plants contained some "inconsiderate text," including elements of the text macrostructure.

Lastly, there was some evidence that some of the teachers were not sensitive to the text content structure or were not highly skilled at condensing text ideas for representation in the frames. With respect to text structure, 4 of the 27 individual frames in social studies did not have an explanation frame as the only primary frame; instead, these frames were of the Primary Description type. As revealed on audiotape, at least one of the teachers did not recognize that the text had a cause/effect structure; she chose to represent the text macrostructure with the "default structure" of simply listing the text ideas (Meyer, 1984). Her frame showed the water shortage as a single topic; under this superordinate category she represented the text as a table with main subordinate categories as *Water Conservation* and *Changes in People's Lives*. She did have *Causes* and *Effects* as two separate category labels, but these concepts were not connected conceptually or graphically. As further revealed on audiotape, this teacher immediately favored a Problem/Solution frame format once it was shown and explained to her by her pair partner.

As mentioned before, some of the variability in frames resulted from different ways of representing the same part of the text, from gist statements to verbatim copying of several or more sentences. These variations may be akin to the summarizing processes or macrorules that have been presented and studied in a number of research articles, notably Brown and Day (1983) and Winograd (1984). "Inventions" combine and transform information across many sentences (or even paragraphs); at the other extreme, "copy-delete" or "reproduction" strategies involve verbatim copying of text language. (In these studies there were significantly fewer inventions among younger and less able readers than among more mature, capable readers.) Thus, teachers interested in

framing might also benefit from practice in condensing selected portions of text into gist statements for inclusion in frames.

The second major part of this study addressed the fourth research question and focused on the framing process that the teachers went through in constructing frames. The individual framing questionnaires indicated that the teachers on average were somewhat confident that their frames "faithfully represented the information in the text"; the grand mean for both content areas was 5.3 on a 1-7 Likert scale. The results of the present study suggest that that confidence is probably not easily justified. The responses from other parts of the questionnaire showed that the aspects of framing a particular text that were considered the most difficult by some teachers were the same aspects that other teachers considered the easiest.

Teacher talk during collaborative work revealed many things about the framing process. Certainly, the teachers had student use and perceptions of frames as top priority. Every major framing decision, from type and organization of frames to the amount of detail to include in frames, was directly or indirectly connected to some consideration of the students who might use the frames. The recordings also supplemented the objective analysis of the frames. Teacher talk gave us an ear into the framing session; the collaborative frame itself was a visual and verbal record of the decisions and concerns. The audiotape transcripts provided particularly interesting insights concerning the ways that the most unusual frames were constructed. Comments made by teachers with prior framing experience showed how informed decisions were made about framing. Thus, the audiotape recordings provided important information about the many dimensions to the framing process. Perhaps because the framing process is multi-dimensional, the teachers' level of prior framing experience seemed to be, in a qualitative sense, the most critical factor in the framing process.

These principal elements of the study support the notion that framing is a complicated and often difficult task. Making a frame is a compositional process like writing an expository analysis of text. Both involve the selection of main ideas and principal structural elements from text; both involve the presentation of a unified analysis. For these reasons among others, the framing process probably can be described as an "ill-structured domain" (Spiro, Vispoel, Schmitz, Samarapungavan, & Boeger, 1987). In framing, as with other ill-structured domains, one cannot specify explicitly all of the steps necessary to construct a frame. The framing process is complex, requiring comprehension of text as the basis of a clear, condensed representation of its essential structure and the gist of its contents. The framing process has irregularity, another property of ill-structuredness. This study showed that the 71 experimental frames varied considerably. Finally, the framing process engages broad areas of content domains which themselves may be ill-structured.

Text framers, like writers, may accomplish work in two main phases: producing and editing (Elbow, 1973). They may do their best work when these phases are discrete. In order for the writer to revise prose successfully, a significant kind of psychological time must pass to allow the writer to switch roles from being a producer of language to being an editor of clear and coherent discourse. Perhaps the project teachers were not permitted enough psychological time for them to switch from a generative mode to an editing mode (either in their individual work or between their individual work and collaborative work). Editing a frame also involves carefully checking it for consistency with the text. The number of incomplete concept categories in teacher frames suggests that many teachers did not systematically use the text to verify the information in their frames. If the teachers were still thinking in their "producing modes" while trying to edit, they probably would not catch mistakes or oversights. With more time for reflection, teachers might also have revised out of their frames more of the text information that the text raters judged as least important.

The appropriate level of detail for inclusion in a frame is yet an unresolved issue that depends in part on the intended purpose of the teacher-constructed frame. Is the frame to be used by students as a *supplement to the text or as a virtual substitute for text*? A commonly held belief among reading professionals and theorists is that *reading is a constructive process* in which comprehension takes place as the reader actively engages text. If students are handed a frame with too much information about the text, the students may just memorize the frame and not build the internal and external connections that are crucial parts of meaningful learning.

Mayer (1989) cautions against overusing conceptual models, especially with high-knowledge and high-ability students whose spontaneous generation of mental models may be inhibited by having to use someone else's representation of a scientific process. In the two studies cited earlier on framing (Armbruster et al., 1987; Armbruster et al., in press), the students in framing conditions helped build their own frames by filling in open frames with particular information they had gleaned for themselves from the text. In these ways, researchers have used graphic organizers as aids but not crutches; with successful guided practice students can gradually assume more and more responsibility for making their own organizers for study of texts.

How can researchers assist teachers to become expert framers? Providing guidelines alone will probably not be adequate. To acquire knowledge successfully in ill-structured domains, Spiro et al. (1987) recommend "a considerable accumulation of case experience" (p. 197). In a study involving expert text writers and learning from text, Duffy et al. (1989) emphasize this suggestion in their conclusions regarding the training of writers to produce interesting text with memorable main ideas. They encourage the use of complex examples and counterexamples in training text writers. Duffy and colleagues also suggest the use of "protocol-aided revisions" in which the text is tested with students rather than submitted to expert judgment. Students think aloud while working with the text in order to provide text writers with some insights about how readers react to text. The same processes could be used with teaching teachers to construct frames for effective student use.

The Framing Project and other inservice opportunities could systematically include the dimensions of instruction and practice for teachers that Duffy et al. propose for text writers. One hopes that the novice text framers would quickly benefit from the expertise of experienced teachers who are also experienced text framers. Teachers could also benefit from student reaction to using teacher-constructed frames. For some teachers, framing could provide some of the kind of intellectual stimulation and professional challenge that Nemser (1983) claims is essential for teachers to have in order to remain effective with students.

Effective framing can provide benefits for the teachers who make frames and for the students who first learn from frames and ultimately learn to make their own frames.

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Table 1

Rhetorical Links for Linked Concept Pair (LCP) Coding

Label		Link: Definition/Example(s)
1	Equivalence	Connects concept to restatement (definition) or identification of the concept/ Conifers produce seeds inside cones. A drought is a long time of dry weather.
2	Characteristic	Connects an attribute or property to a concept/ Most conifers have needles.
3	Example	Connects a specific instance or a specific object to the larger classification that it represents/ One way that people saved water was to water their gardens with used water from bathtubs. A bristlecone pine is a conifer.
4	Type	Connects the divisions of a classification of objects or ideas/ Conifers may be tall or short in height.
5	Effect	Connects a reason or cause to a result, or connects an enabling condition to a result. Because crops were lost, the price of vegetables rose. With adequate water, people survived.
6	Sequence	Connects an event to another event that followed it/ After cones open, seeds are released.
7	Comparison	Connects two things that are similar to or different from each other/ Cone-bearing plants are different from flowering plants.
8	Alternative	Connects one possible course of action to another possible course of action/ People could save water or die.
9	Analogy	Connects two things by a figure of speech comparing them/ Conifer have needlelike leaves. (See also "Characteristic.")
10	Answer	Connects a response to a question/ How did people conserve water? They did so in different ways.
11	Part	Connects a component to a whole thing or idea/ Actions and results are two parts of the solution to a problem.

Table 2

Levels and Types of Teacher Frames

Teacher Work Units: I - Individual, P = Pair, G = Group

FRAME LEVEL & TYPE		TEACHER WORK UNIT		
Science	I	P	G
1 Primary frame, 0 secondary			
Description	5	0	0
2 Primary frames, 0 secondary			
Comparison/ contrast & Description	0	1	0
Comparison/ contrast & Explanation	2	0	0
Description & Explanation	9	3	1
*1 Primary frame, 1 secondary frame			
Description, Comparison/ contrast	1	0	0
Description, Explanation	10	3	1
TOTAL	27	7	2
Social Studies	I	P	G
1 Primary frame, 0 secondary			
Description	2	0	0
Explanation	20	6	1
2 Primary frames, 0 secondary			
Description & Explanation	1	0	0
Explanation & Explanation	3	0	0
*1 Primary frame, 1 secondary frame			
Description, Explanation	1	0	0
Explanation, Description	0	0	1
TOTAL	27	6	2

* For embedded frames, the type of Primary frame is listed first.

Table 3

Average Number of LCP units in Teacher Frames *and* Average Number of Social Studies Text Idea Units in Teacher Frames

Teacher Work Units: I = Individual P = Pair G = Group

Average Number of LCP units in Teacher Frames

	I	P	G
Science (*sd*)	31.6 (5.6)	32.4 (7.6)	37.5 (.5)
Social Studies (*sd*)	24.0 (4.8)	26.2 (6.9)	23.0 (1.0)

Social Studies Frames: LCP Units and Text Idea Units

	I	P	G
Linked Concept Pairs (*sd*)	24.0 (4.8)	26.2 (6.9)	23.0 (1.0)
Text Idea Units (*sd*)	23.5 (5.6)	25.3 (3.0)	27.5 (1.5)

Table 4

Differentiation of Structure for Selected Concepts as Represented in Frames on "Cone-Bearing Plants"*

I = Individual frames
P = Pair frames
G = Group frames

Concept		(*n*)	Explicit	Implicit	Other
Size					
	I	(23)	.43	.22	.35
	P	(6)	.67	.00	.33
	G	(1)	.00	.00	1.00
Shape					
	I	(21)	.67	.10	.24
	P	(6)	.50	.00	.50
	G	(2)	.50	.00	.50
Needles					
length					
	I	(26)	.12	.23	.65
	P	(6)	.17	.33	.50
	G	(2)	.00	.00	1.00
shape					
	I	(22)	.09	.32	.59
	P	(7)	.14	.29	.57
	G	(2)	.00	.00	1.00
growth					
	I	(24)	.17	.38	.46
	P	(7)	.00	.43	.57
	G	(2)	.00	.00	1.00

Text Headings & Frame Category Labels			Explicit	Implicit
			Cone-bearing	Conifers
	I	(27)	.48	.52
	P	(6)	.33	.67
	G	(1)	.00	1.00
			Kinds	Characteristics
	I	(25)	.56	.44
	P	(5)	.40	.60
	G	(2)	.50	.50
			Life Cycle	Seed production
	I	(23)	.96	.04
	P	(6)	1.00	.00
	G	(2)	1.00	.00

* Numbers indicate the proportions of frames having the designated degree of structure (explicit, implicit, or other).

Table 5

Completeness of Information Within Selected Concept Categories in Frames on "Cone-Bearing Plants"*

I = Individual frames
P = Pair frames
G = Group frames

Concept		(*n*)	Complete	Incomplete
Size				
	I	(23)	.96	.04
	P	(6)	1.00	.00
	G	(1)	1.00	.00
Shape				
	I	(21)	.86	.14
	P	(6)	.83	.17
	G	(2)	1.00	.00
Needles				
length				
	I	(26)	.96	.04
	P	(6)	1.00	.00
	G	(2)	1.00	.00
shape				
	I	(22)	.82	.18
	P	(7)	.71	.29
	G	(2)	.50	.50
growth				
	I	(24)	.82	.18
	P	(7)	.71	.29
	G	(2)	.50	.50
Life Cycle				
pollen starts				
	I	(17)	.18	.82
	P	(4)	.25	.75
	G	(0)	----	----
seed starts				
	I	(6)	.67	.34
	P	(2)	.50	.50
	G	(1)	1.00	.00

* Numerals indicate the proportions of frames having the designated degree of completeness of information.

Table 6

Accuracy of Information Within Selected Concept Categories in Frames on "Cone-Bearing Plants" *

I = Individual frames
P = Pair frames
G = Group frames

Concept		(*n*)	Accurate	Inaccurate
Size				
	I	(23)	.83	.17
	P	(6)	.83	.17
	G	(1)	.50	.50
Shape				
	I	(21)	.48	.52
	P	(6)	.67	.33
	G	(2)	.50	.50
Needles				
length				
	I	(26)	1.00	.00
	P	(6)	1.00	.00
	G	(2)	1.00	.00
shape				
	I	(22)	.96	.05
	P	(7)	.86	.14
	G	(2)	1.00	.00
growth				
	I	(24)	1.00	.00
	P	(7)	1.00	.00
	G	(2)	1.00	.00
Life Cycle				
ALL LCP units				
	I	(278)	.95	.05
	P	(69)	.96	.04
	G	(28)	.89	.11

* Numerals indicate the proportions of frames having the designated level of accuracy of information.

Table 7

Completeness and Accuracy of Selected Concepts in Teacher Frames on Social Studies Lesson, "A Limited Resource"

LCP	CONCEPT	LINK	CONCEPT
1	pasture turn brown	*	not enough grass/ grass died
2	not enough grass	*	farmers feed cattle hay
3	not enough grass	*	cows no milk
4	crops lost	*	vegetable prices up
5	trees die	*	danger of forest fires
6	insects to coast	*	people leave beaches
7	insects to water	*	spread disease & spoil water
8	rats to water	*	spread disease & spoil water

* 5 = Cause-Effect; 2-5 = Incomplete causal LCP; 3-5 Inaccurate causal LCP

The proportions in the table are given for each category. Each row sums to 1.00. The *n* stands for the number of frames in which an LCP unit occurred. For the Teacher Frames: I = Individuals; P = Pairs; G = Groups.

LCP	(*n*)		COMPLETE & ACCURATE	INCOMPLETE	INACCURATE
1	20	I	.50	.50	.00
	4	P	1.00	.00	.00
	2	G	.50	.50	.00
2	16	I	.50	.50	.00
	4	P	1.00	.00	.00
	1	G	.00	1.00	.00
3	21	I	.43	.57	.00
	5	P	1.00	.00	.00
	2	G	.50	.50	.00
4	27	I	.48	.44	.07
	6	P	1.00	.00	.00
	2	G	.50	.50	.00
5	23	I	.35	.57	.09
	4	P	.50	.25	.25
	2	G	.00	.50	.50
6	20	I	.45	.40	.15
	4	P	1.00	.00	.00
	2	G	.50	.50	.00
7	13	I	.38	.38	.23
	2	P	1.00	.00	.00
	1	G	1.00	.00	.00
8	21	I	.48	.43	.10
	4	P	1.00	.00	.00
	2	G	.50	.50	.00

Table 8

Analysis of Social Studies Explanation Frames with Respect to Ready-Made Problem/Solution Formats

Overall, 20 of 27 (74%) of the individual teachers' frames were organized as one Primary Explanation frame; 7 of 8 (88%) of the collaborative frames were of the same type. These frames were selected to analyze with respect to their following a ready-made Problem/Solution format. (Ready-made formats are illustrated in Figures 3, 4, and 7, and are discussed in the text of this report.)

Numerals in the table indicate the proportion of teacher-constructed frames that fulfilled the criteria for the format qualities of completeness, explicitness, or accuracy.

A. Individual (I) vs. Pair (P) vs. Group (G) Teacher Work Units

	I (20)	P (6)	G (1)
Frame Format Quality			
Completeness	.75	1.00	1.00
Explicitness	.40	.50	1.00
Accuracy	.35	.83	1.00

B. Individual (I) vs. Collaborative* (C) Teacher Work Units

	I (20)	C (7)
Frame Format Quality		
Completeness	.75	1.00
Explicitness	.40	.57
Accuracy	.35	.86

*NOTE: "Collaborative" results combine Pair and Group results.

Table 9

Grand Proportions: Occurrence in Teacher Frames of Highest and Lowest Rated Groups of Text Idea Units

Teacher Work Units: I = Individuals; P = Pairs; G = Groups
C = Collaborative (Pairs and Groups

1. Science

	I (27)	P (7)	G (2)
TEXT RATING			
Highest 15% (11 Idea Units)	.41	.34	.36
Lowest 13% (9 Idea Units)	.32	.29	.44

	I (27)	C (9)	All Frames (36)
TEXT RATING			
Highest 15% (11 Idea Units)	.41	.34	.39
Lowest 13% (9 Idea Units)	.32	.32	.32

2. Social Studies

	I (27)	P (6)	G (2)
TEXT RATING			
Highest 17% (10 Idea Units)	.42	.48	.35
Lowest 15% (9 Idea Units)	.20	.20	.20

	I (27)	C (8)	All Frames (35)
TEXT RATING			
Highest 17% (10 Idea Units)	.42	.45	.43
Lowest 15% (9 Idea Units)	.20	.22	.21

Table 10

Summary of Responses to Individual Framing Questionnaires

		RESPONSE ITEMS			
		1	2	6	7
CONTENT AREA	(*n* =)				
Science	(27)	3.4	4.3	5.1	4.3*
(*sd*)		(1.3)	(1.3)	(1.6)	(1.3)
Social Studies	(27)	3.3	4.5	5.4	3.7*
(*sd*)		(1.5)	(1.3)	(1.3)	(1.5)
Totals	(54)				
GRAND MEAN		3.4	4.4	5.3	4.0*
(*sd*)		(1.4)	(1.3)	(1.5)	(1.5)

* *Note.* One teacher did not respond to item 7, so means for item 7 are based on *n* = 26 for each content area and a total of 52.

Table 11

Individual Teachers' Opinions on the Hardest and Easiest Aspects of Framing the Experimental Texts

Aspect of Framing	Hardest	Easiest	Both*
Science text			
Frame type or kind (deciding)	8	2	X
Number of frames (deciding)	4		
Determining text organization	3	3	X
Amount of text information (coping with)	3		
Amount of information in frame (deciding on the)	3	1	X
Using flow chart organization		5	
Social studies text			
Organizing text ideas	6	1	X
Frame type or layout (deciding)	4	3	X
Narrowing text information	2	2	X
Poor text wording/organization (coping with)	2	1	X
Filling in frame	2	1	X

* *Note*. "Both" refers to the situation in which an aspect of framing was claimed to be the hardest by at least one teacher and claimed to be the easiest by at least one other teacher.

Table 12

Topics of Teacher Talk during Collaborative Work on Frames

NOTE: Part of the guidelines for collaborative work included a suggestion for members to share individual frames and a request to use a checklist of topic areas, as follows:

central idea(s) and main details of text
dominant structural pattern of text
format of collaborative frame
main topics for use in collaborative frame

	Content Area Text			
Topic of Talk	Science (9)	Social Studies (8)	TOTAL (17)	Both
Students	9	8	17	X
Students fill out frame	5	7	12	X
Clarity of presentation in frame	4	4	8	X
Individual frames, same information	6	7	13	X
Text organization	3	5	8	X
Type of frame	7	2	9	X
Number of frames (1 vs. 2)	9	4	13	X
Graphic format of frame	5	8	13	X
Amount of ideas in frame	2	2	4	X
Amount of detail in frame	7	5	12	X
Prior experience with framing	6	3	9	X
Hardest part of doing this frame	5	4	9	X
Prior knowledge as source	5	0	5	
Use of complete sentences in frame	0	3	3	
Use of standard frame patterns	0	3	3	

Figure Captions

Figure 1. Text structures (and frame formats), after Armbruster (1985) and Ransom et al. (1989).

Figure 2, Part A. Teacher-constructed frame on "Cone-Bearing Plants."

Figure 2, Part B. Linked Concept Pair (LCP) coding of teacher-constructed frame.

Figure 3. Problem/Solution frame.

Figure 4, Part A. Teacher-constructed frame on social studies text.

Figure 4, Part B. LCP coding of teacher-constructed frame on social studies text.

Figure 5. Variant partial frames and LCP codings (science text).

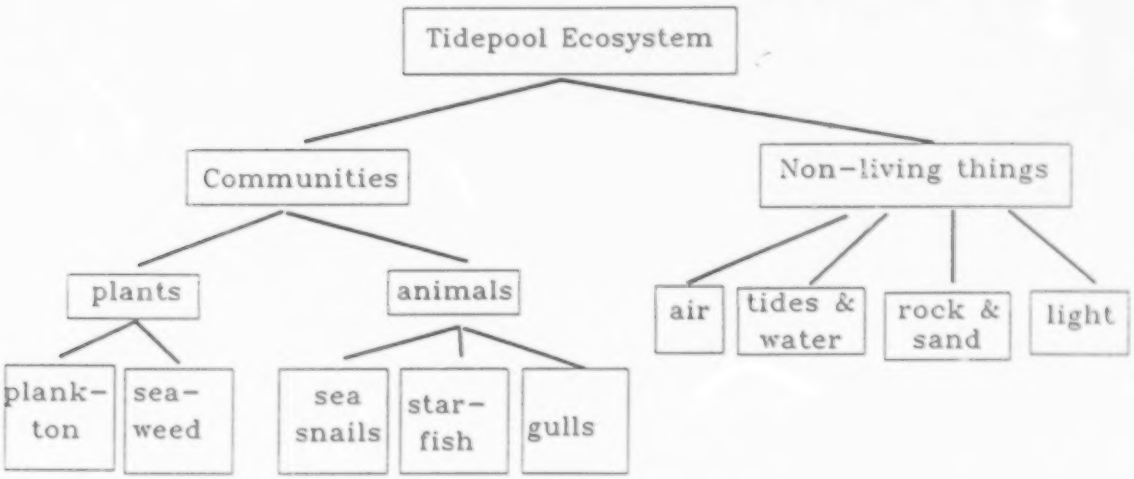
Figure 6. Variant partial frame (social studies) and LCP codings.

Figure 7. Alternate format of Problem/Solution frame.

Figure 8. Textbook publisher's frame on science text (from Barman, DiSpezio, Gruthrie, Leyden, Mercier, Ostlund, & Armbruster, 1989, pp. 8, 10).

Figure 1 Text Structures (and Frame Formats), after Armbruster (1985) and Ransom et al. (1989)

1. Description (branching tree, wheel, or table)



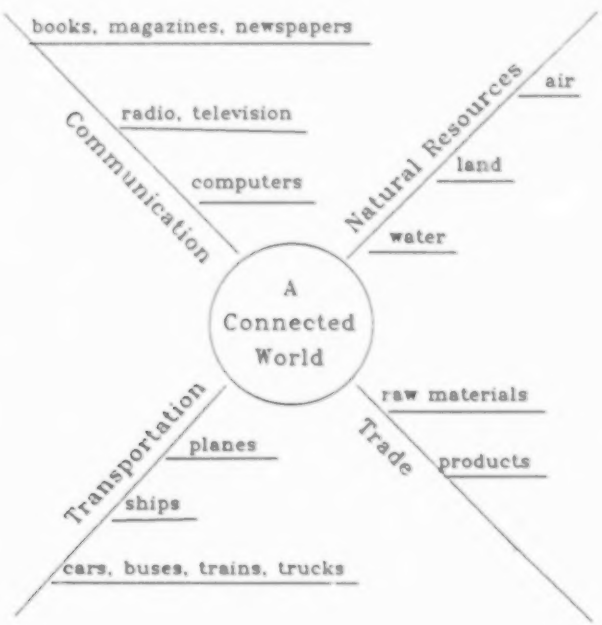


Figure 1 (continued)

THE NETHERLANDS

Land	Water	Agriculture	Commerce & Industry
sand dunes lowlands	North Sea canal system 3 large rivers	garden plants dairy products	international trade oil refineries natural gas

2. Comparison/contrast (matrix)

	Nile River	Amazon River
Location	Africa; flows through desert	South America, mostly in Brazil; flows through rain forest
Length	the world's longest river	the world's second longest river
Uses	water for crops; water power for electricity	transportation, mostly of raw materials

3. Explanation (chain)

Plants in Pond Succession

Figure 2, Part A
Teacher-Constructed Frame on "Cone-Bearing Plants"

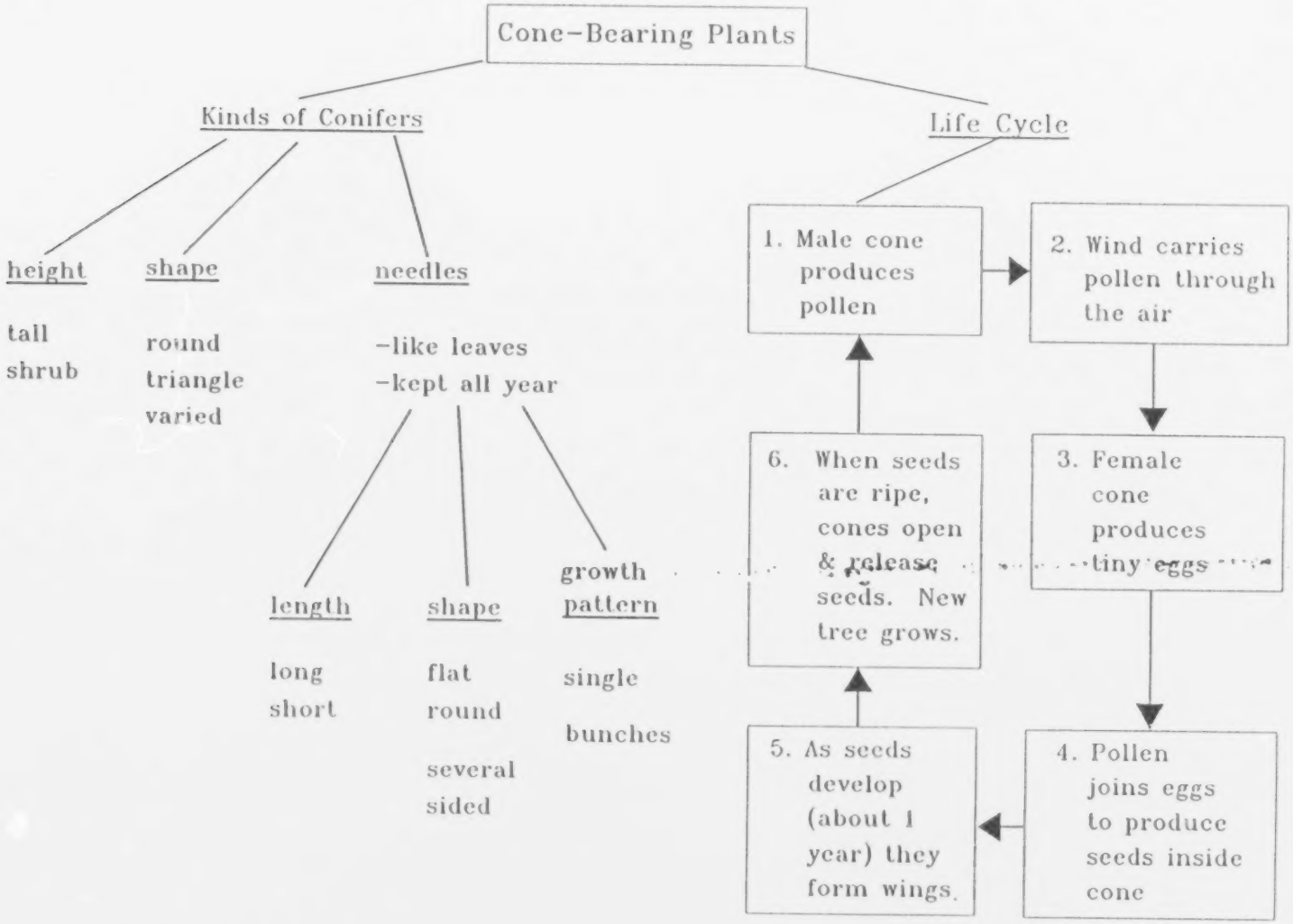


Figure 2, Part B

Linked Concept Pair (LCP) Coding of Teacher-Constructed Frame

Cone-bearng plnts	0	(lesson title)
kinds of confrs	0	cone-bear plnts
size (height)	0	kinds of confr
tall/large	4	size
short/low/shrub	4	size
shape	0	kinds of confr
round	4	shape
triangular	4	shape
varied	4	shape
needles	2	confrs (knds of)
needles	9	leaves
kept all year	2	needles
length	0	needles
long	4	length
short	4	length
shape	0	needles
flat	4	shape
round	4	shape
several sided	4	shape
growth pattern	0	needles
single	4	growth
bunches	4	growth

Life cycle	0	Cone-bear plants
male	4	cone
female	4	cone
life cycle	6	pollen (strts cycle)
male cone	6	produce pollen
pol carry by wind	6	female cone
female cone	6	produces eggs
pollen + egg	6	= seed in cone
seeds	6	one-year develop
seeds develop	6	form wings
seeds ripe	6	cones open
cones open	6	release seeds
released seeds	6	new tree
new tree	6	prod pol (full cycle)

LINK MENU

0	Category heading (generic)
1	Equivalence
2	Characteristic
3	Example
4	Type
5	Effect
6	Sequence
7	Comparison
8	Alternative
9	Analogy
10	Answer
11	Part

Figure 3
Problem/Solution Frame
(after Ransom et al., 1989)

The Problem/Solution frame explains actions or events in terms of problems and their solutions. The problem can be stated simply or analyzed into three parts--a cause, a negative situation, and the effect of that negative situation on the people involved. The solution (or attempted solution) has two parts--actions taken to try to solve the problem, and the results of those actions, including the solution (if there was one), and any other anticipated or unanticipated outcomes.

PROBLEM/SOLUTION FRAME

PROBLEM OF Bushmen		
Situation		Effect on People
1) Lack of food	⇒	1) starvation--death
2) Lack of shelter		2) danger from animals and weather
3) Lack of clothing		3) exposure to weather and terrain

⇓

SOLUTION		
Actions		Results
1) Gathering, some hunting	⇒	1) Food obtained
2) Huts built		2) Protected from sun/weather
3) Use animal skins		3) Protected body from sun

Figure 4, Part A

Teacher-Constructed Frame on Social Studies Text

Problem - Lack of Water (drought) in England/Wales, 1974 - Sept. 1976

Situation		Effect on People
1. not enough grass 2. crops lost 3. trees began to die/forest fires 4. insects flew to coast 5. rats headed for rivers 6. reservoirs began to dry up	⇒	1. cows no longer gave milk 2. price of vegetables rose 3. fewer trees to enjoy 4. drove people from beaches 5. spread disease 6. water had to be carefully used

⇓

Solution

Actions		Results
1. reused bath water - gardens - people 2. water carried by hand from tanks in street 3. water shut off in parts of city for part of day 4. firefighters stood guard 5. people used less water	⇒	- able to save water until rains came in Aug./Sept. 1976 - taught people how they depended on each other - people learned to work together

Figure 4, Part B

LCP Coding of Teacher-Constructed Frame on Social Studies Text

LINK MENU

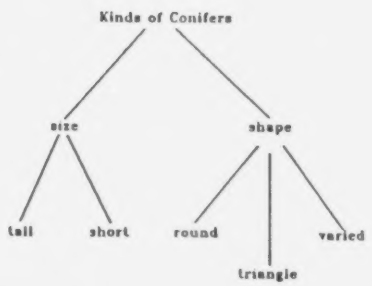
0	Category heading (generic)
1	Equivalence
2	Characteristic
3	Example
4	Type
5	Effect
6	Sequence
7	Comparison
8	Alternative
9	Analogy
10	Answer
11	Part

CONCEPT	LINK	CONCEPT
*Problem	0	superordinate
drought (E/Wales)	2	problem
drought	1	long dry period (lack water)
*Situation	11	Problem
*Effect	11	Problem
*situation	5	effect
not enough grass	5	cows no milk
crops lost	5	vegetable prices up
trees die	2-5	danger of forest fires
trees die	5	fewer trees
forest fires	5	fewer trees
insects to coast	5	people leave beaches
rats to water	5	spread disease & spoil water
reservoirs dry up	5	water must be carefully used
*Solution	0	superordinate
*Problem	5	Solution
*Actions	11	Solution
*Results	11	Solution
*actions	5	results
Reused bath wtr/grdns	5	
Reused bath wtr/peopl	5	
wtr from tanks in strt	5	
wtr shut off prt day	5	
fire fighters guard	5	
pepl savd, usd les wtr	5	
	5	pepl save till rains (8-9/76)
	5	taught pepl depnd on each othr
	5	pepl lernd to work together

* 9 of 28 LCP units for standard format of Problem/Solution frame

Figure 5
Variant Partial Frames and LCP Codings (Science Text)

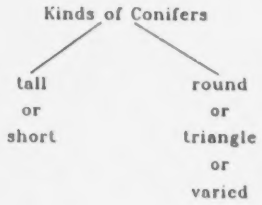
A. Explicit



LCP CODING

size	0	kind of conifir
tall	4	size
short	4	size
shape	0	kind of conifer
round	4	shape
triangle	4	shape

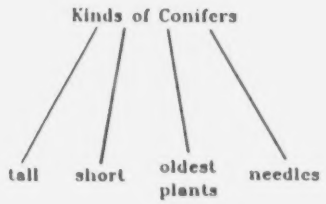
B. Implicit



LCP CODING

tall (size)	4	kind of conifer
short (size)	4	kind of conifer
round (shape)	4	kind of conifer
triangle (shape)	4	kind of conifer
varied (shape)	4	kind of conifer

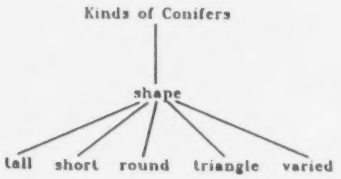
C. General



LCP CODING

tall tree	2-4	kind of conifer
short tree	2-4	kind of conifer
old plant	2	kind of conifer
needles	2	kind of conifer

D. Inaccurate



LCP CODING

shape	0	kind of conifer
tall	3-4	shape
short	3-4	shape
round	4	shape
triangle	4	shape
varied	4	shape

Figure 6

Variant Partial Frame (Social Studies) and LCP Codings

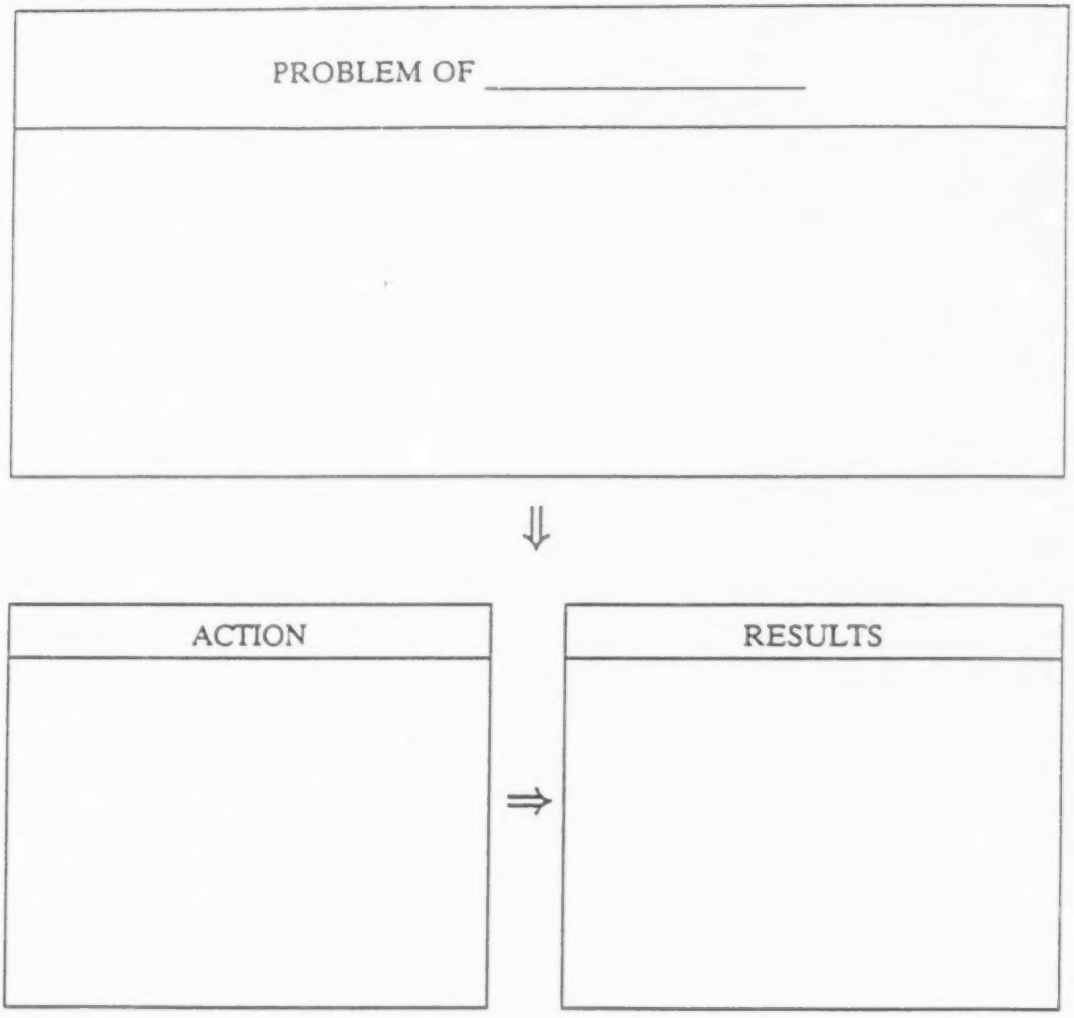
(This frame was part of one constructed by a teacher new to the Framing Project.)

PROBLEM		
Situation		Effect on People
England and Wales were experiencing a drought in 1974-75.	⟹	1. farmers crops were lost 2. trees died 3. Price of vegetables rose 4. rats & insects were seeking water; they spoiled water and spread disease 5. Increase of forest fires 6. Water had to be carried by hand from tanks.

CONCEPT	LINK	CONCEPT
*Problem	0	superordinate
*Situation	11	Problem
*Effect	11	Problem
*situation	5	effect
drought (E/Wales)	2	problem
crops lost	2-5	vegetable prices up
trees die	2-5	danger of forest fires
insects to coast	2-5	people leave beaches
rats to water	2-5	spread disease/spoil wtr
drought kept on	2-5	wtr from tanks in strt

* LCP units for standard format of Problem/Solution frame

Figure 7
Alternate Format of Problem/Solution Frame
(after Armbruster, Anderson, & Ostertag, 1987)

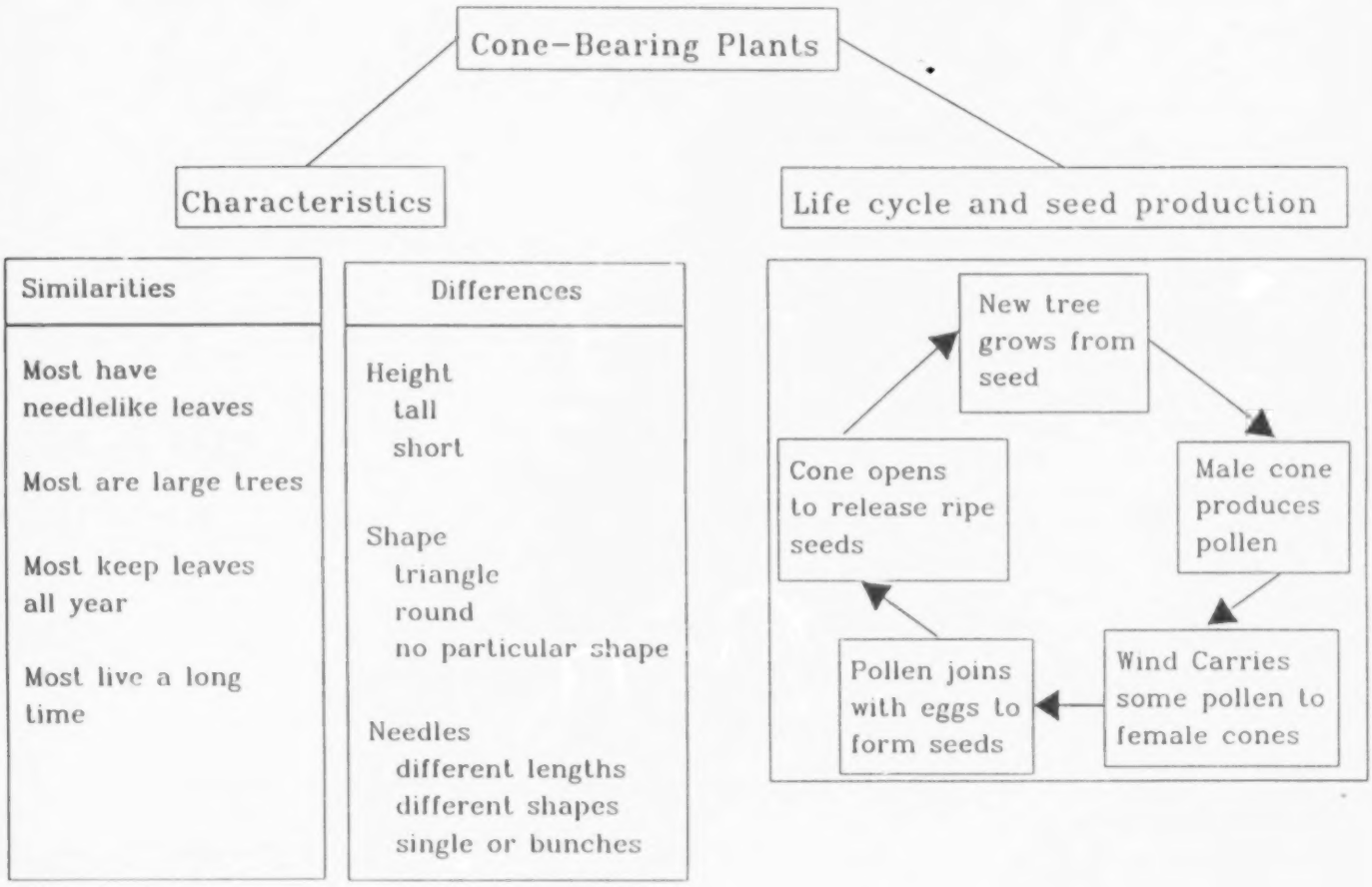


PROBLEM = something bad; a situation that people would like to change

ACTION = what people *do* to try to solve the problem

RESULTS = what happens as a result of the action; the effect or outcome of trying to solve the problem

Figure 8
Textbook Publisher's Frame on Science Text (from Barman, DiSpezio, Gruthrie, Leyden, Mercier, Ostlund, & Armbruster, 1989, pp. 8, 10)



Appendix A: Experimental Science Text

This has been retyped from *Addison-Wesley Science* (Barman et al., 1989, pp. 46-48). The "graphic" designation indicates only the captions from pictures and diagrams; the pictorial parts have not been reproduced here.

Lesson 2 Cone-Bearing Plants

Most of the plants you are familiar with are flowering plants. You just learned that flowering plants produce seeds in flowers. Another group of plants produces seeds, but the seeds are not produced in flowers. The seeds are in cones like pine cones. Plants that produce seeds in cones are called **conifers** (KAHN uh furz). Pine trees and cedar trees are conifers.

The largest plants on the earth are the sequoia and redwood tree. Both are conifers. They can grow as tall as a 30-story building.

The oldest plants on the earth are also conifers. The oldest tree in the world is a bristlecone pine. It is 4,600 years old.

[Graphic 1:] Giant sequoia [Graphic 2:] Bristlecone pine

Life Cycle of a Conifer. Conifers have a life cycle that begins with a seed. The seed can grow into a new plant. The new adult plant can then make its own seeds.

Conifers have two different kinds of cones. One kind of cone is small and soft. This small cone is the male cone. It produces pollen. The other cone is larger. It is the female cone and produces tiny eggs. Wind carries pollen from the male cones to the female cones. A part of the pollen joins with the eggs to produce seeds. The seeds take about one year to develop.

As the seeds develop, they also form what look like wings. When the seeds are ripe, the cones open. The seeds are carried on their wings by the wind. If the seeds land in a good place, new trees begin to grow.

[Graphic 3:] How Conifer Seeds Develop

1. The male cone of a conifer produces pollen.
2. The wind carries pollen through the air.
3. Some pollen is carried to female cones. It joins with eggs to form seeds inside the cones.
4. When the seeds are ripe, the cones open and release the seeds.

[Graphic 4:] Blue spruce [Graphic 5:] White pine [Graphic 6:] Atlantic white cedar

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Kinds of Conifers. Conifers differ from each other in several ways. Some are very tall trees. Others are shrubs that grow close to the ground. Conifers have many different shapes. Some are round and some have a triangle shape. Still others have no particular shape.

Most conifers have needlelike leaves. The trees have needles all year long. Different conifers have different kinds of needles. Some conifers have short needles, others have long needles. Some have needles with several sides. Others have needles that are flat or rounded. Some have needles that grow as single needles. Others have needles that grown in bunches of two or more.

Look at the pictures at the top of the page. How does each tree differ in shape? How are the needles of each tree different?

Appendix B: Experimental Social Studies Text

This has been retyped from *Scott, Foresman Social Studies* (Parramore & D'Amelio, 1979, pp. 123-126). The "graphic" designation indicates only the caption from a picture; the pictures have not been reproduced here.

Chapter 12
A Limited Resource

Water is an important resource. Without it, the people of the world would die. Sometimes there is little or no rain, though. What happens then?

Lesson 1 England and Wales in 1976

In England and Wales there was very little rain and snow during 1974 and 1975. The amount of rain in January, February, and March of 1976 was far less than usual too. April was even worse. Yet, many people were not worried. "It is sure to rain soon," they said.

It did not rain. By the end of May, the **drought** had become a problem. Grass in many pastures had turned brown. Farmers had to feed their cattle hay because the animals could not find enough grass to eat. Many cows no longer gave milk. Without water, crops were lost.

[Graphic 1:] The Dolygaer Reservoir [do lē gār´ rez´ ər vwär] in southern Wales dried up completely.

[Graphic 2:] People in Bideford, England, lined up to show what their lives might be like as the drought got worse.

The price of vegetables rose. Trees began to die. Forest fires became a great danger.

Millions of insects flew toward the coast of England seeking water. The insects drove people away from the beaches. Looking for water, rats headed for

rivers and lakes too. They spoiled the water and spread the danger of disease. Reservoirs began to dry up. The little water left had to be carefully used.

Everyone had to save water. People chose to do it in different ways. Some people watered their gardens with used water from bathtubs and kitchen sinks. In the London zoo, the elephants' bath water was used again to water the plants. Showers use less water than baths, so many people made the choice to take showers. Some families chose to use the same bath water for more than one person. Each day, programs on the TV gave people ideas for saving water.

The drought kept on. Water had to be carried by hand from tanks set up in the streets. In some places people were allowed to use water for only part of the day. Water was shut off in homes in some towns in Wales form 2 P.M. every afternoon to 7 A.M. the next morning.

Fire fighters stood guard by parks and forests to put out any fires that might begin. The leaves were dry, and the summer was hot. Many forests caught fire. Fanned by strong winds, the fires raced through the forests. Fire fighters worked day and night. In the small town of Crickhowell, Wales, the fire fighters had to share just one bucket of water to wash up in after putting out a fire in their town.

Nearly one hundred days passed without rain. Finally, the rains came in August and September, 1976. The drought was over, but the water shortage was not. The amount of water in reservoirs was still very small. People still had to save water. Several more months of rain were needed before the water crisis was over.

During 1976, people in England and Wales had to make important choices about the little water they had to use. Everyone knew that one person taking one more bath was not the problem. The problem came when everyone chose to use more water. Then the danger of running out altogether might really happen. The water crisis taught people how much they depended on each other. People learned to work together to share and save the amount of water they had.

Appendix C: Individual Framing Questionnaire

Name _____

QUESTIONNAIRE ABOUT FRAME NO. 1

Directions: Circle the number of your response.

1. How difficult was it to make this frame?

1	2	3	4	5	6	7
very easy						very difficult

2. Was making this frame harder or easier than you thought it would be?

1	2	3	4	5	6	7
much harder						much easier

3. What, if anything, was hardest about making this frame?

4. What, if anything, was easiest about making this frame?

5. Considering your work in making this frame, estimate the relative influence of the following sources. Please rank order them, using 1 for the most influential source.

_____ your own prior knowledge of the subject matter topic

_____ your prior experience with framing

_____ the text that you framed

6. How confident do you feel that your frame faithfully represents the information in the text?

1	2	3	4	5	6	7
very doubtful						very confident

7. How similar do you think that your colleagues' frames will be to yours?

1	2	3	4	5	6	7
very similar						very different

Appendix D: Frequency and Proportion of Occurrence in Frames of Highest and Lowest Rated Text Idea Units

Idea unit number corresponds only to its order in text. Only the "stable" idea units are included. The code below refers to the teacher work units:

I = Individual P = Pair G = Group

Proportions are listed directly below each frequency.

Science: Highest Rated 15% of Text Idea Units

Mean importance rating of 11 units = 3.75 (range 3.50 - 4.00)

Average standard deviation = .32 (range .00 - .50)

	Text Idea Unit GR = Graphic	I *n* = 27	P 7	G 2
1	Most of the plants you are familiar with are flowering plants.	13 .48	2 .29	0 0.0
6	The seeds are in cones like pine cones.	7 .26	0 0.0	0 0.0
7	Plants that produce seeds in cones are called **conifers** (KAHN uh furz).	13 .48	4 .57	1 .50
19	**Life Cycle of a conifer.**	23 .85	6 .86	2 1.00
20	Conifers have a life cycle that begins with a seed.	6 .22	2 .29	1 .50
36	If the seeds land in a good place, new trees begin to grow.	9 .33	3 .43	2 1.00
GR3	**How Conifer Seeds Develop**	0 0.0	0 0.0	0 0.0
GR4	The male cone of a conifer produces pollen.	22 .81	5 .71	1 .50
GR7	Pollen joins with the eggs to form seeds inside the cones.	6 .22	1 .14	0 0.0
GR8	When the seeds are ripe, the cones open and release the seeds.	9 .33	1 .14	0 0.0
37	**Kinds of Conifers**	14 .52	2 .29	1 .50
GRAND PROPORTION = $\frac{\text{sum of occurrences}}{(\#\text{ frames})(\#\text{ units})}$ =		.41	.34	.36

Science: Lowest Rated 13% of Text Idea Units

Mean importance rating of 9 units = 1.68 (range 1.25 - 2.00)

Average standard deviation = .49 (range .43 - .60)

Text Idea Unit GR = Graphic		I *n* = 27	P 7	G 2
14	Sequoias can grow as tall as a 30-story building.	18 .67	4 .57	1 .50
15	Redwood trees can grow as tall as a 30-story building.	14 .52	3 .43	1 .50
17	The oldest trees in the world is a bristlecone pine.	7 .26	2 .29	1 .50
18	One bristlecone pine is 4,600 years old	7 .26	0 0.0	0 0.0
GR9	Blue spruce	5 .19	1 .14	1 .50
GR10	White pine	4 .15	1 .14	1 .50
GR11	Atlantic white cedar	4 .15	1 .14	1 .50
44	Other conifers have no particular shape.	19 .70	6 .86	2 1.00
55	Look at the pictures at the top of the page.	0 0.0	0 0.0	0 0.0
GRAND PROPORTION = $\frac{\text{sum of occurrences}}{(\#\text{ frames})(\#\text{ units})}$ =		.32	.29	.44

Social Studies: Highest Rated 17% Text Idea Units

Mean importance rating of 10 units = 3.59 (range 3.38 - 3.75)

Average standard deviation = .60 (range .43 - .71)

Text Idea Unit GR = Graphic		I n = 27	P 6	G 2
2	Water is an important resource.	4 .15	0 0.0	0 0.0
3	Without water, the people of the world would die.	1 .04	1 .17	0 0.0
13	By the end of May, the drought had become a problem.	18 .67	5 .83	2 1.00
25	Reservoirs began to dry up.	19 .70	6 1.00	2 1.00
27	Everyone had to save water.	23 .85	6 1.00	1 .50
45	Nearly one hundred days passed without rain.	3 .11	2 .33	0 0.0
46	Finally, the rains came in August and September, 1976.	13 .48	2 .33	1 .50
48	but the water shortage was not over.	8 .30	1 .17	0 0.0
51	Several more months of rain were needed before the water crisis was over.	3 .11	0 0.0	0 0.0
57	People learned to work together to share and save the amount of water they had.	21 .78	6 1.00	1 .50
GRAND PROPORTION = $\frac{\text{sum of occurrences}}{(\#\text{ frames})(\#\text{ units})}$ =		.42	.48	.35

Social Studies: Lowest Rated 15% Text Idea Units

Mean importance rating of 9 units = 1.83 (range 1.38 - 2.38)

Average standard deviation = .59 (range .48 - .70)

Text Idea Unit GR = Graphic		I *n* = 27	P 6	G 2
10	Yet, many people were not worried.	0 0.0	0 0.0	0 0.0
11	"It is sure to rain soon," they said.	0 0.0	0 0.0	0 0.0
22	The insects drove away people from the beaches.	15 .56	4 .67	2 1.00
29	Some people watered their gardens with used water from bathtubs and kitchen sinks.	25 .93	6 1.00	2 1.00
39	The leaves were dry,	3 .11	0 0.0	0 0.0
40	and the summer was hot.	1 .04	0 0.0	0 0.0
42	Fanned by strong winds, the fires raced through the forests.	0 0.0	1 .17	0 0.0
43	Fire fighters worked day and night.'	1 .04	0 0.0	1 .50
44	In the small town of Crickhowell, Wales, the fire fighters had to share just one bucket of water to wash up in after putting out a fire in their town.	4 .15	0 0.0	0 0.0
GRAND PROPORTION = $\frac{\text{sum of occurrences}}{(\#\text{ frames})(\#\text{ units})}$ =		.20	.20	.28